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Contents.

	PAGE
The Melchett-Turner Conference	155
In Proper Perspective	155
The Influence of Nickel and Chromium upon the Growth of Grey Cast Iron	156
Fuel Economy in the Cupola	157
Blast-Furnace Development in the United States in 1928	158
Random Shots	158
A Novel Method of Cupola Charging	159
Bean Cars, Limited, Appoint New Director	160
The Keeping of Foundry Costs	161
British Facilities for Foundry Training—No. VII	163
Patternshop Standardisation	164
Melting Practice in the Foundry	166
Some Notes on Patternmaking	167
New Companies	170
Trade Talk	170
Obituary	170
Nottingham Society of Engineers	170
Personal	170
Wills	170
Proposed Iron and Steel Inquiry	170
Catalogues Received	170
Iron and Steel Markets	172

THE FOUNDRY TRADE JOURNAL IS THE OFFICIAL ORGAN OF THE INSTITUTE OF BRITISH FOUNDRYMEN; THE WELSH ENGINEERS' AND FOUNDERS' ASSOCIATION, AND THE FOUNDRY TRADES EQUIPMENT AND SUPPLIES ASSOCIATION.

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Forthcoming Events.

MARCH 5.

Sheffield Metallurgical Association:—Ordinary meeting at Sheffield. "Some Aspects of the Wire Drawing Process," Paper by F. C. Thompson, D.Met., B.Sc.

Institute of British Foundrymen.

MARCH 7.

Birmingham Branch:—Ordinary meeting. "History of Iron-founding in the Midlands," Paper by D. H. Wood.

MARCH 9.

Birmingham Branch (Junior Section):—Ordinary meeting at Birmingham. "Liquid Shrinkage," Paper by J. Hird.
Scottish Branch:—Ordinary meeting at Glasgow. "Salvage of Defective Castings," Paper by E. Longden.

The Melchett-Turner Conference.

The Melchett-Turner Conference was started, as many movements in this country are started, by private individuals in the hope that an understanding could be reached which might commend itself to the country as a whole. It was started with the utmost sincerity of purpose and intentions, but evidence has not been wanting that a number of representative organisations in the country view the proposals made by the Conference for a National Industrial Council with some misgiving. The tendency on the part of the Press has been to criticise this misgiving as an attempt to crab in its early stages a movement which might prove of the highest importance in the history of relations between capital and labour. We are forced, however, to recognise that the point of view of the critics is at least as sincere and sympathetic as that of the original promoters of the Conference, and the ability to steer the Conference into less troubled waters will be a real task for industrial statesmen on both sides.

The Melchett-Turner Conference agreed that a National Industrial Council should be formed and that it should contain representatives of the workers (from the General Council of the Trades Union Congress) and of employers (nominated by the Federation of British Industries and the National Confederation of Employers' Organisations). The Council, it is suggested, should hold quarterly meetings for consultation on the very widest questions concerning industry and for the establishment of Joint Conciliation Boards. The topics to be covered by the discussion of the National Industrial Council concern the whole field of industrial activity, including unemployment, wages, organisation and control, finance and industrial relations.

The objections to the formation of a Council have been felt by large numbers of employers' organisations, but the British Engineers' Association has actually taken the step of publishing its objections with the hope of giving a lead to others, and as many of these bodies are constituent members of the Federation of British Industries, and as many of the people forming the Melchett-Turner Conference hold important representative positions, the difficulties of the F.B.I. and the National Confederation of Employers' Organisations will be considerable.

The objections may be summarised very briefly. The General Council of the Trades Union Congress is constituted and fitted to deal with questions of wages, hours and working conditions. It is not necessarily competent to deal with the wide range of industrial, economic, commercial and financial matters to be discussed by the National Industrial Council. It is felt that a much wider variety of interest and expert knowledge would be necessary if the Council were to arrive at decisions which are to be based on facts rather than on feelings. A Trades Union Congress represents less than one-third of the insured persons engaged in industry and trade, so non-union labour and unaffiliated trades unions would have no voice in the proposed Council. More important still, the brains of industry, that is, management, technical staff and industrial administrations have no representatives and no opportunity of contributing their knowledge and experience. Since these men are, as a rule, highly educated, and since they are unbiassed in the sense that they have at heart the good of the industry rather than the good of either party in it, they represent a balancing force of the very greatest importance. Finally, the opposition urges that the Trades Union Congress cannot be dissociated from the Labour Party and its political programme, and they do not see how employers organised on an industrial and therefore non-political basis can discuss industrial matters with a body which is committed to political aims. In short, the opposition wants assurance that by going into the Conference the Trades Union Congress is out to improve the British industrial system rather than destroy.

In Proper Perspective.

We have naturally been extremely interested in the "scare" headlines recently appearing in the daily Press having reference to recent developments in the cast-iron foundry trade. It so happens that we have been present at the meeting where the "developments" were confidentially disclosed to a scientific gathering, also at the dinner where they hinted at. Curiously enough we failed to find any reason for the assumption that anything of a revolutionary character was about to be disclosed. At the London meeting the first Paper to be discussed was of a purely academic character, and it showed that distinct progress had been made by the British Cast Iron Research Association towards the completion of a constitutional diagram for iron-carbon-silicon alloys covering the various compositions known as cast iron. The research also showed that a great amount of work still remains to be done before the scientists themselves will be satisfied as to the various aspects involved. The foundry owner naturally asks, "How will that affect me?" It will enable his metallurgical advisers to be more definite in their answers to his queries. It will enable a hundred and one short cuts to be made in investigational work. Yet it will never tell the whole story, as cast iron is not and never will be a ternary alloy.

The second part of the proceedings at this meeting was devoted to a research on the "growth" of cast iron upon repeated heatings and cooling. Here it was demonstrated that in excessive quantity, a progressively deleterious factor changes its nature and becomes beneficial. This is distinctly fascinating, and we shall await the industrial tests with interest, but this discovery is not epoch making.

An advance by the Research Association, not disclosed at that particular meeting, but of infinitely greater industrial benefit, relates to the discovery of a critical percentage of manganese. This finding, if generally confirmed, is of prime importance to such widely separated sections of the industry as chilled roll manufacture and black heart malleable production.

Foundry owners should be sceptical of any revolutionary developments. Evolution has added a minimum of six tons per square inch to the average tensile strength of cast iron during the last quarter of a century, and systematic work will enhance in a similar manner all the other properties of this interesting alloy.

XUM

The Influence of Nickel and Chromium upon the Growth of Grey Cast Iron.*

The influence of nickel upon the graphitisation of cast iron is about the same as that of silicon; it acts, however, in a more moderate manner. From this it may be concluded that nickel, like silicon, favours the growth of cast iron. Some authors, however, state that this is not quite true. Several experiments with irons containing nickel and chromium were recently made by E. Piwowarsky and W. Freytag. The test-samples were heated and cooled in air several times from 500 to 900 deg. C. and the change in length was measured by a universal dilatometer. One heating and cooling took about 1¾ hours. The results of the first series of experiments are recorded in Table I. The samples designated "S" were cast into dry sand moulds, and after cooling were annealed at 400 deg. C. for half an hour in order to

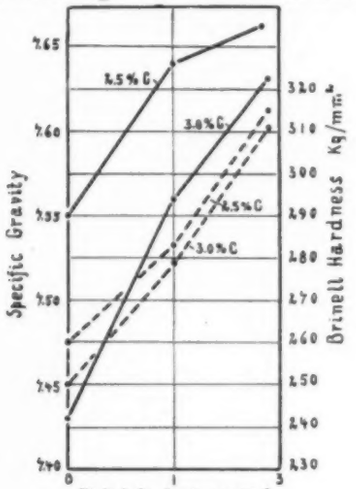


Fig. 1.

remove the casting stresses. The samples designated "K" were cast into iron moulds lined with fireclay and heated to about 100 deg. C. After cooling these samples were quickly heated to 925 to 950 deg. C. in a gas-fired muffle furnace; immediately after the temperature was reached the source of heat was shut off and the samples were allowed to cool in the furnace. From Table I it can be seen that nickel does not favour the growth of the irons investigated. Even sample No. EA_3S, containing 2.83 per cent. of nickel, gave a smaller change in length than sample No. 6S containing no nickel and about the same percentage of silicon. Chromium, on the other hand, diminishes the growth to a perceptible degree.

Further experiments were made with two irons containing different percentages of total carbon, silicon, and nickel. The irons were molten in the Tammann furnace at 1,600 deg. C., kept at this temperature for 6 to 8 mins., and cast into a dry-sand mould with a diameter of 15 mm. The mould had been preheated to red heat in order to insure a grey structure of the samples containing low silicon. The experimental data are recorded in Table II. The samples with nickel, though containing a higher percentage of carbide, gave a smaller change in length than the samples free of nickel. The fairly high increase in length of sample No. IX was due to some hard spots in the texture caused by the low silicon content. The microscopic examination showed that because of the high melting-temperature the graphite was finely distributed. Any real influence of the nickel content on the size of the graphite could not be postulated. From an etched specimen it could be seen that nickel favours the sorbitic formation of the matrix, a fact which was also confirmed by the Brinell test. The hardness and the specific gravity (examined by the hydrostatic method) are recorded in Fig. 1. In spite of the increasing hardness the machinability of the samples was not greatly affected.

Further experiments were made with irons melted *in vacuo*. The raw materials were Swedish pig- and nail-iron. The samples were heated to 1,400 deg. C. in a wholly evacuated porcelain tube, kept at this temperature for half an hour and slowly cooled. The changes in length of these samples after heating and cooling them four times between 500 and 900 deg. C. are recorded in Table III. These results, too, show that nickel does not favour the growth of cast iron. In general, the change in length decreases with the decreasing silicon content in spite of the increasing nickel content, with the exception of sample No. 8 (compared with sample No. 6). The microscopic examination showed that with sample No. 8 the size of the graphite was by far larger than with the other samples. Though, in general, a distinct influence of the nickel content upon the size of the graphite could not be stated, it may be concluded from sample No. 8 that a nickel content from 5 to 6 per cent. may enlarge the graphite flakes slightly, especially when the silicon content is high. By adding chromium to the irons the growth is greatly diminished in spite of the increasing nickel content (samples Nos. 4 and 5). The good behaviour of the samples melted *in vacuo* can also be seen from Fig. 2 where the experimental results given in the Tables II and III are graphically illustrated. This behaviour is chiefly caused by the increased density and the decreased gas content of the samples.

As to the influence of the superheating temperature, the authors found with samples containing no nickel and chromium that the higher the temperature the smaller the change in length provided that the samples had been kept at the high temperature for a sufficiently long period. Jolting the molten iron had no distinct influence upon the growth. Further experiments with irons containing nickel and chromium showed that the

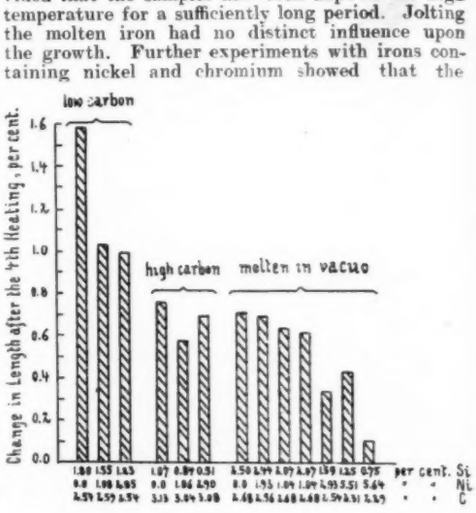


Fig. 2.

growth is at a minimum when the graphite is present in the form of temper carbon. Experiments with samples heated in steam revealed the fact that at 450 deg. C. ordinary cupola iron and special iron only underwent a slight increase in volume and weight; at 550 deg. C., however, this increase was very perceptible, especially with the ordinary iron.

Table I.

Sample No.	Melting temp. Deg. C.	Casting temp. Deg. C.	T.C. Per cent.	Gr. Per cent.	Si. Per cent.	Mn. Per cent.	S. Per cent.	P. Per cent.	Ni. Per cent.	Cr. Per cent.	Change in length after the 4th heating and cooling. Per cent.
6S ..	1,500	1,400	24	2.78	1.96	0.59	0.028	0.023	—	—	1.12
EA_2S ..	..	..	2.8	2.39	1.74	0.58	0.022	0.084	0.89	—	0.84
EA_3S ..	..	..	2.21	2.44	1.70	0.60	0.026	0.08	2.83	—	0.96
EA_4S ..	..	..	3.02	2.25	1.74	0.62	0.025	0.096	2.94	0.76	0.08
EA_1K ..	..	..	3.0	2.02	1.74	0.60	0.024	0.084	3.10	0.80	0.08
EB_3S ..	1,520	..	2.6	1.88	2.27	0.56	0.026	0.092	—	—	1.08
EB_4S ..	1,490	..	2.69	2.05	2.09	0.52	0.025	0.084	2.80	0.49	0.32
EB_4K ..	1,490	..	2.69	2.07	2.00	0.68	0.016	0.060	2.69	0.47	0.23

Table II.

Sample No.	Melting Temp. Deg. C.	T.C. Per cent.	Gr. Per cent.	Si. Per cent.	Mn. Per cent.	S. Per cent.	P. Per cent.	Ni. Per cent.	Change in length after the 4th heating and cooling. Per cent.
7 ..	1,600	3.13	2.19	1.07	0.07	0.04	0.03	—	0.75
XI ..	..	3.04	2.03	0.88	0.07	0.04	0.03	1.06	0.58
IXa ..	..	3.08	1.94	0.46	0.47	0.04	0.03	2.90	0.70
8 ..	..	2.54	1.64	1.85	0.06	0.02	0.04	—	1.57
XII ..	..	2.59	1.55	1.52	0.06	0.02	0.04	1.08	1.06
X ..	..	2.54	1.45	1.34	0.06	0.02	0.04	2.85	1.00

Casting temp. All the melts were poured immediately from the furnace.

Table III.

Sample No.	T.C. Per cent.	Gr. Per cent.	Si. Per cent.	Mn. Per cent.	S. Per cent.	P. Per cent.	Ni. Per cent.	Cr. Per cent.	Change in length after the 4th heating and cooling. Per cent.
1	2.68	2.30	2.50	0.07	0.013	0.069	—	—	0.71
2	2.56	2.20	2.44	0.07	0.013	0.066	1.93	—	0.70
3	2.68	2.35	2.07	0.06	0.008	0.076	1.04	—	0.65
3a	2.68	2.35	2.07	0.06	0.008	0.076	1.04	—	0.62
4	2.61	1.98	2.13	0.07	0.006	0.069	0.98	0.26	0.348
5	2.54	1.76	2.02	0.06	0.006	0.063	2.92	0.49	0.165
6	2.54	1.86	1.59	0.01	0.013	0.069	2.93	—	0.34
7	2.47	1.67	1.54	0.07	0.08	0.069	2.96	0.25	0.24
8	2.31	1.76	1.25	0.08	0.008	0.065	5.51	—	0.425
9	2.29	1.40	0.75	0.06	0.019	0.068	5.64	—	0.112

Melting Temp.: 1,400 deg. C.
Casting Temp.: All the melts solidified in the furnace *in vacuo*.

* "Die Giesserei," 1928, No. 48, pp. 1193/1200.

Fuel Economy in the Cupola.*

By N. D. Ridsdale (Consulting Metallurgist).

Everyone wishes to save coke in melting pig-iron to-day for the foundry when the price of castings is generally very low. In the short time available it is only possible to touch on a few of the essential points which contribute to success in this direction. These may be summarised as follows:—(1) Quality of cokes; (2) thickness of layer of fusion coke; (3) regularity of charging; (4) height of coke bed; (5) volume of blast; (6) size of tuyeres.

As regards No. 1 the quality of the coke depends both upon its composition and physical qualities. It is false economy to use a poor coke in order to save 1s. or 2s. per ton in first cost. A good hard

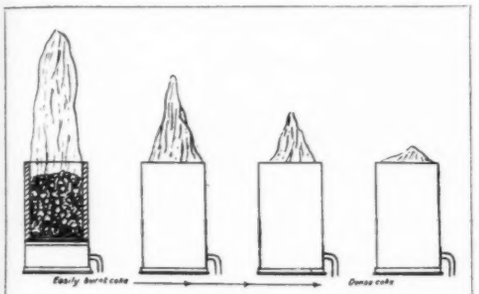


FIG. 1.

dense coke is essential, and it is important that it should not contain many big lumps more than about 6-in. cube, nor much small under about 2-in. cube. The reason for this will be emphasised later on. A good coke should not contain more than 8 per cent. of ash and 2 per cent. moisture. How many foundries in this district know the ash and moisture contents of their coke? Yet 5 per cent. extra ash and moisture means a waste of probably about 7 per cent. of fuel. A good deal is being said to-day about the re-activity of coke. For our purpose we can regard this term as referring to the readiness with which coke will be acted upon by carbon dioxide to form carbon monoxide. A soft coke is readily acted upon at high temperatures by carbon dioxide and converted to carbon monoxide with loss of heat. If foundries wish for the maximum fuel economy their aim must be to burn the coke to carbon dioxide as completely as possible, and to avoid the carbon dioxide reacting on further coke above it and being converted to carbon monoxide. Mr. H. Koppers in a Paper entitled "Coke and its Behaviour in the Foundry" points out that if different kinds of coke of equal size are burnt in small vertical furnaces under equal blast pressure, then the easily-consumed varieties will produce chiefly carbon monoxide; whereas the harder and less easily burnt kinds will give principally carbon dioxide. The speed of combustion of a soft and easily burnt kind of coke will be twice that of the hard coke. A further feature is the appearance of a long carbon-monoxide flame with easily burnt coke. (See Fig. 1.)

Thickness of Layers of Fusion Coke.

This is a most important factor in fuel economy, and is practically independent of the diameter of the cupola. Generally speaking, it should be about 6 in. deep when using a good quality hard coke, but as different brands of coke differ in hardness and re-activity the best thickness for a given kind of coke can only be found by experiment. Having found the correct thickness of the coke layer this should not be altered for a given cupola, though the weight of the charge of metal for different qualities of iron may need to be varied from time to time. It should be understood that the best thickness is that which draws the blast to penetrate it and form a short flame of carbon dioxide with as little carbon monoxide as possible. Once the carbon dioxide is completely formed any additional thickness of coke only results in a reversion to carbon monoxide and a loss of heat. The weight of coke to be charged is best determined by enclosing a circular space on the floor with bricks 6 in. high and of the same internal diameter as that of the cupola at tuyere level. This space should then be filled up to the height of 6 in. with coke, and the coke required to fill this should then be weighed; this weight of coke should then be used regularly and only altered if the quality and moisture content should change appreciably at any time.

Regularity of Charging.

If founders are to reduce their coke to a minimum they cannot afford to allow a big margin for irregularities, therefore it is most important to see that the charging takes place in such a manner that the weights of the charges are regular and the layers of coke and iron are as even as possible. The fusion zone is the shape of an inverted cone, the apex of which is on a level with the tuyeres, as is shown diagrammatically in Fig. 2. At the base of it, about 2 ft. above the tuyeres, the height of the coke bed must be such that at no point does the blast come in contact with the iron to be melted until it has been completely deprived of its oxygen by passing through a suitable thickness of coke. Hence, as a rule the coke bed is at least 2 ft. above the level of the tuyeres. This distance, however, varies with the (1) velocity of the blast; (2) reactivity of the coke; (3) the size of the coke. The higher the velocity and the larger the coke pieces the higher must be our coke bed; the greater the reactivity of the coke the lower the coke bed.

Volume of Blast.

Since the combustion of the coke is largely governed by the quantity of blast supplied, it is obvious that it is as important to measure the volume of the blast as it is to measure the quantity of coke charge. Yet how many cupolas in the Cleveland district are fitted with volume meters? No doubt the foundries know the pressure of their blast, but this is by no means sufficient. The installation of a volume meter is not an expensive matter and is very well worth while; in fact, it is essential if we want to control the

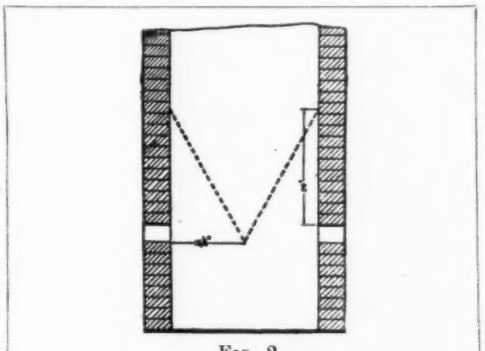


FIG. 2.

cupola properly and effect the greatest economy in working. Mr. R. W. Muller, in an article on fuel economy of the cupola, printed in "Geisserei Zeitung, 1928," No. 14, pp. 425-9, quotes a most interesting series of experiments made in two series. In the first * the charge coke used was kept constant at about 7.5 per cent. of the weight of iron, whilst the blast was varied from 1,270 cub. ft. per min. by increments up to 2,650 cub. ft. per min., the output went up from 2.99 to 4.54 tons per hr., whilst the thermal efficiency rose to a maximum at 2,120 cub. ft. of blast per min. and then diminished as further blast was added. In series 2 the blast ill go, and inserts a at 2,120 cub. ft. per min., whilst the charger into was gradually increased from 6.29 per's the chain to 12.38 per cent. In this case the maximu nd the put was obtained with 6.29 per cent. charge c on and it fell gradually from 5.01 tons per hr. to 3.16 tons per hr., when the charge coke was 12.38 per cent. In this case the maximum thermal efficiency was obtained with 6.29 per cent. charge coke. It should be noted that the temperature of the iron was 1,411 deg. C. with the lowest coke consumption, and it was only 1,435 deg. C. with the highest coke consumption. These figures are most illuminating. Evidently 2,120 cub. ft. gave blast of the right velocity to burn completely the carbon to carbon dioxide when 6.29 per cent. coke was used. The thickness of this layer was about 7 in. More charge coke increased the thickness of the layer and caused more and more carbon dioxide to be converted into carbon monoxide, with an absorption of heat and consequently a diminution in output. The maximum charge coke of 12.38 per cent. must have been about 14 in. thick, which was very much in excess of what was necessary.

Size of Tuyeres.

It is generally conceded to-day that the best practice is to have large tuyeres, having a cross sectional area of from about 18.25 per cent. of the cross sectional area of the cupola where the tuyeres enter. The blast pressure can then be reduced to, say, 10 oz. for a 54-in. dia. cupola. The tuyeres should be splayed. High pressure blast, with small tuyeres gives a much more uneven distribution of the blast in the cupola—hence less regular combustion. Table I shows a

TABLE I.

	Modern practice.	Poumay.	R. W. Muller.
Cupola diameter ..	54"	54"	27.6"
Blast pressure ..	10 ozs.	18 ozs.	not known
Tuyere Area—			
Cupola area	17–18%	9%	28%
Volume c. ft. per hr. per sq. inch ..	135–150	170	213
Charge coke	7–8%	6.7%	6.3%
CO in gases at throat	5–10%	0.2%	2.4%
Thickness of charge coke layer	5–6"	6"	7.2"
Rate of burning of coke per sq. inch per hr. of cross sec. area of cupola ..	1–1.1 lbs.	0.92 lbs.	1.18 lbs.
Iron melted per 1 sq. inch of cross sec. area cupola per hr.	13–16 lbs.	13.7 lbs.	18.75 lbs.

comparison of some of the essential features of modern cupola practice compared with those just quoted from Muller's experiments and the Poumay system based on particulars furnished by a user.

It is hoped that these remarks will stimulate discussion and result in the local foundries carefully considering how they can effect greater fuel economy in the cupola. A foundry making 30 tons of iron in 5 days a week, reducing its coke consumption from, say, 10 per cent. to 8 per cent., would save 3 tons of coke per week, or 150 tons per year.

MR. ALFRED C. BOSSOM, in an address before the Institution of Structural Engineers last week, said that structural engineers had in their hands one of the greatest opportunities of revising the cost of building construction in England. The standardised structural steel frame was not usual in this country yet, but if it could be introduced a larger amount of building at a considerably reduced cost could be undertaken. Mr. Bossom urged the Institution to make every effort to get the various building laws and regulations so revised that it would be an advantage to use British steel.

Nickel-Chromium-Iron Alloys.—A special committee for research on nickel-chromium-iron alloys has recently been formed by the American Society for Testing Materials, the aim being to "promote general knowledge of the properties of the alloys of this system and to develop such methods of test and ultimately such specifications as may be warranted by progress in the development and use of these alloys."

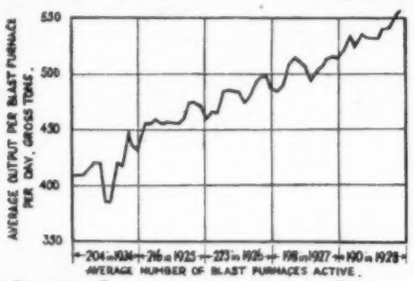
* A Paper read before the Middlesbrough Branch of the Institute of British Foundrymen, Mr. S. V. Toy presiding.

* See Table II, FOUNDRY TRADE JOURNAL, Sept. 27, 1928 p. 229.

Development in the United States in 1928.

The current issue of "Blast Furnace and Steel" has an interesting communication by MR. A. BERG on this subject, from which we reproduce the subjoined particulars. According to the author, development in the blast-furnace field in the United States during 1928 has had the same general trend as during the immediately preceding years; that is development along lines already established in the endeavour to further improve methods of operation, increase efficiency, improve quality and lower costs. With the exception of one new blast furnace having been completed in 1928 for application in a new field, the chemical industry, there were during 1928 no additional new units. The enlargements and improvements of existing units has, however, been continued, an increasing number of furnaces having moved from the classification of small or medium size to ones of very large hearths. At the end of 1928 there were upwards of 100 furnaces with hearth diameters of 20 ft. or over. Several furnaces have been built of 24 and 25 ft. hearth diameters, and one furnace is now being rebuilt to 26-ft. diameter hearth. The largest diameter stock line on record is 19 ft., with a 14-ft. diameter big bell.

The number of existing blast furnaces has decreased from 353 in number to 338. Likewise the average number of furnaces actually operating in 1928 was only 190, whereas the average number



SHOWING INCREASE IN THE AVERAGE OUTPUT PER BLAST FURNACE IN THE UNITED STATES.—"THE IRON AGE."

operating in 1927 was 200 and 210 in 1926. Complete compilation of pig-iron production records for 1928 show an output of 37,837,000 tons of pig-iron, against 36,300,000 for 1927, and 38,100,000 for 1926.

An increased number of furnaces have for a month's run or more approached and exceeded 1,000 tons average per day. Monthly production of over 32,000 tons per furnace has been recorded. These high tonnages have been accompanied by lower fuel consumptions, improvement in quality and decrease in operating costs. For a period after and during the development of the very large hearth furnaces, it may be said that the importance of establishing the maximum tonnages which could be produced and handled on a single unit, to some extent overshadowed the importance of improving practice, especially in regard to fuel consumption and still more specifically in regard to losses or amount of flue dust produced per ton of pig-iron. This last question is now occupying a place in the minds of blast-furnace operators.

Reduction in Flue-Dust Losses.

With the larger stock lines necessary and desirable with the larger furnaces to keep down velocity of gases and through the lower velocity also minimise flue-dust production, it has been found of importance to change the once almost universal difference of 4 ft. between stock-line diameter and big bell. Dovel has clearly demonstrated under local conditions the beneficial effect on flue-dust losses by increasing the stock-line diameter, thereby slowing down the velocity of the exit gases. Also marked improvement in his practice has been accomplished by making the diameter of the big bell smaller in proportion to the stock-line diameter than has been generally accepted as standard. As a result of this demonstration, as well as results indicated by engineers of the U.S. Bureau of Mines, operators and engineers have turned their serious attention to the proper proportioning of diameter of large bell to stock line, increased diameter of stock line, stroke of bell and speed of operation of bell.

The remarkable results obtained and claimed for the adoption of larger stock-line diameter and for the proper proportioning of stock line and bell by Dovel were a slowing down of exit-gas velocity to 5 ft. per sec., accompanied by flue-dust reduction from 110 lbs. per ton of iron to about 15 lbs. per ton. Tonnage also was increased by 30 per cent. and fuel consumption reduced by 16 per cent. For these results Dovel adopted an 8-ft. 4-in. big bell for a 15-ft. 6-in. stock line and observed a very much more regular operation.

Serious attention is given in many quarters to the economical advantage in the preparation of raw materials, that is following German precedent to eliminate as far as possible the real fines and also, of course, the real coarse or lumpy materials, and to consider using these fines as sinter. The advantages would be larger tonnage on existing size furnaces, with lower coke consumptions, which results would be gained through the additional cost of sintering. Experimentation is being made with washing of ore to separate the fines and to determine the economy of thus providing a more suitable and more open burden.

Hot-Stove Design.

Hot-blast stove design and construction is still following general orthodox lines in so far as they are still of the regenerative type and with fittings of established use. However, some interesting departures as to detail design of chequer work and design and arrangement of combustion chambers have been made. Two installations have been made with round and square chequer openings of 4¾ in. and with 2⅝ to 1 11/16-in. diagonal inserts put into the chequer openings, giving exceptionally good results in lower stack temperatures, higher efficiency, and providing the possibility of very large heating surfaces in comparatively small stove shells.

Stoves with outside combustion chambers have been built and found advantageous, especially in regard to better distribution of air and gases and elimination of strains and stresses in brickwork characteristic of side combustion stoves of flat arch design. Construction has also been started on stove linings made up of 3½-in. diameter round and 3-in. square alternate openings with a wall thickness in the chequer of 1⅝ in. and with a decisive departure in stove-bottom construction where special heat- and oxidation-resisting castings are used instead of brick piers, arches and transverse tile in the bottom of the stove. This minimises trouble from distortion due to expansion and contraction and simplifies brick laying, and also gives very large heating surfaces in comparatively small stove shells.

Several installations have been made, designed to preheat the air or gas entering the stoves. In one case it has been found possible to raise the temperature of the blast entering the stove from 180 to 450 deg. Fah. In another case the temperature of the gas entering the stove has been raised from 70 to 160 deg. Fah. In the former case the sensible heat of the stack gases is utilised, while in the latter case the sensible heat from raw gases from the furnace is used.

Cleaning of Gas.

The dry method of cleaning gas has during the year again received considerable attention. A complete installation of electric precipitation has been built and started at the Fairfield plant in Birmingham, Ala. The installation is for both stoves and boilers, and has incorporated several improvements of design. This method of gas cleaning is being given consideration in the north at present as a possible advantageous means of final or secondary cleaning after gas washers for that super-cleanliness and dryness required for blast-furnace gas in its adoption for certain small chequer stoves, boilers and metallurgical fuel. The adaptability and economy of using blast-furnace gas for fuel gas for coke ovens and for metallurgical heating has long been recognised. Several installations have been made, using blast-furnace gas as fuel gas for coke ovens.

We reproduce from a recent issue of "The Iron Age" a graph showing the more or less steady increase in the average daily output of American blast furnaces from 400 tons in 1924 to 525 tons and more in 1928.

Random Shots.

There is a great tendency in these days of hustle to dub an organisation by its initials. We are all familiar with the Besa, and stockbrokers talk easily about Bats. Did you ever notice the great run on the initials of the I.B.F.? Apart from the Institute of British Foundrymen, they are used for British Industries Fair and Federation of British Industries.

* * *

To a casual observer it might seem that the dominating motive of this twentieth century of ours is making and breaking of records (not gramophone records, though they come in for their share, too). Some of them, of course, are important and epoch-making, like the first Atlantic flight, or—in the very distant past—the first Channel swim. Some of them are interesting, if not particularly significant, like the longest solo flight or the first racing car driven by a woman. Some are fantastic and thrilling—the achievement of incredible speeds or the demonstration of tremendous endurance. Some are merely stupid, like the recent American attempt to see how long a couple could go on dancing without a pause.

* * *

But the thing does not end with feats attempted and performed. With a little ingenuity there is hardly anything that cannot be made to achieve a record of some sort. We are not told that it is "a bitterly cold winter," but that it is "the coldest winter for ten years"—or for twenty, or a hundred, if possible! And if that cannot be managed with any regard for the truth, then at least we must be assured that it is the coldest February, or the coldest winter in London, or in the Hebrides, or in Eastern Europe, or the coldest winter with the most sunshine—there are endless possibilities in the game once you begin it!

* * *

The tendency even invades quite serious departments of life, like industry. We are told triumphantly of the largest industrial merger in the country, or of the biggest single order placed with a given firm, or of the largest casting ever produced by so-and-so, and so forth and so on.

* * *

One is tempted to ask whether it is entirely a modern tendency, sprung from the movie habit of extravagance and exaggeration, and fostered, in the business world at least, by keen competition and the general hustle. Or has it always been so? Did the Pharaohs, for instance, broadcast the fact that they were erecting positively the largest Pyramids in the world? Was the Great Wall of China hailed as the longest barrier ever known? Did Cæsar furnish the journalists of ancient Rome with welcome copy when he made the first, actually the first, known invasion of Britain? Perhaps we are not quite so original nowadays as we should like to think!

* * *

Albert recently took advantage of a day trip to London, and he had a walk round the City. When he came back, I asked him what had impressed him most, and he said, "Ba goom, there's a chap in Lunnon that lives in a great big swagger house on top o' Ludgate Hill, and he doesn't half keep pigeons neither."

* * *

SOME NEW HOWLERS.

The chief work of the British in Egypt since 1880 has been the extermination of the sphinxes.

Sir Walter Scott was called the Blizzard of the North. He tried to reach the North Pole but died in the attempt.

"Heard melodies are sweet, but those unheard are sweeter." Paraphrase: It is nice to hear music, but it is still nicer not to.

What should the Lady of Shalott have done instead of lying down in the boat and wasting her life because Sir Lancelot took no notice of her? She should have looked out for another.

MARKSMAN.

A Novel Method of Cupola Charging.*

By R. J. H. Ritchie.

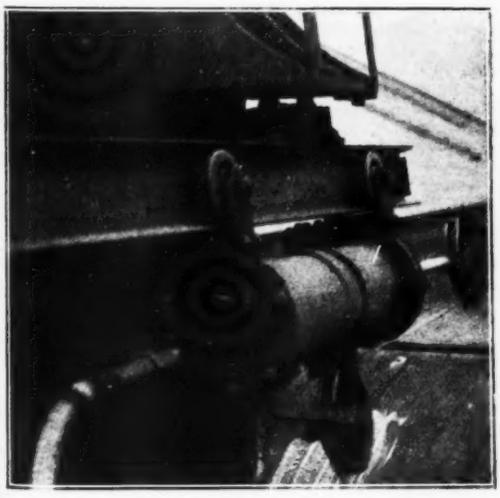
The object of this Paper is to outline a method by which foundry owners may, by means of a small capital expenditure, obtain mechanical charging and effective control of the cupola. The charging barrow is a very important item in cupola economics. The author's firm used to keep a joiner to do nothing else but make or mend wooden barrows. However, about six years or more ago, in consultation with some local steel experts in this line, the bogie shown in Fig. 1 was evolved. This is made of ⅜-in. plate with manganese steel wheels, and although recently patched, looks like

FIG. 1 (ABOVE).—THE BOGIE.

FIG. 2 (TOP RIGHT).—THE BOGIE ON THE HOIST, SHOWING WEIGHING MACHINE.

FIG. 3 (BOTTOM RIGHT).—PUSHING THE BOGIE OFF THE LIFT.

FIG. 4 (BELOW).—THE CHARGER IN OPERATION.

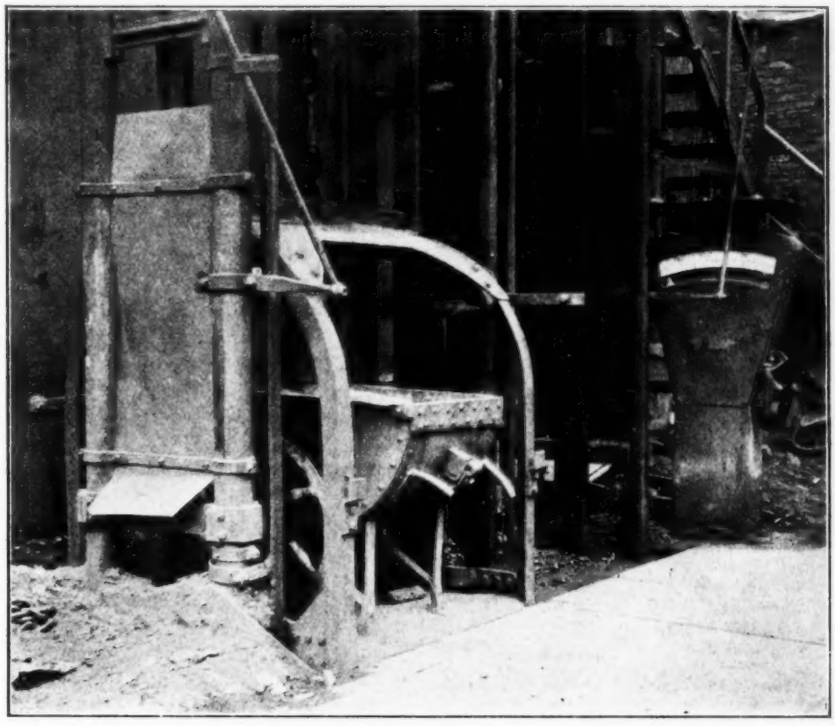


lasting another six years. There are seven now, none of which has been out of service.

These bogies as shown are loaded with 9 cwt. of pig-iron or scrap, or 3¼ cwt. of coke, and are easily handled on iron plates by one man. They are filled and wheeled on to a weighing machine (Fig. 2), opposite the bottom of the cupola lift, which is of the balanced or double-cage type, so that the only lift is the actual charge, and not the cage or bogie. The weighing-machine dial is marked with two red lines, which show exactly when 3¼ cwt. of coke or the 9 cwt. of pig-iron or scrap have been reached or exceeded. The tare is in all cases the same, and the men soon acquire wonderful judgment of the load.

The charge hand up the stairs operates the lift, and pushes the loaded bogie up to the charging door (Fig. 3), as far as it will go, and inserts a bolt on the end of the wire from the charger into an eye at back of bogie. He then pulls the chain operating the air valve of the charge, and the bogie nose engages with two heavy C.I. lips on the bottom side of the charging door, while the back suddenly lifting, tips the charge.

One would say that either the materials would be distributed unevenly in the cupola or that the lining opposite the charging door would be damaged, but it is surprising that both a level charge and a lining even less damaged than by hand loading are obtained. The charger is a cast-iron pipe 8 in. diameter, bored 8¼ in., with a piston and rod and two pulleys. It is rather a Heath-Robinson effort, and is shown in Fig. 4. It is served by a 1½-in. rubber air hose, and is movable to either cupola. The operating valve



* A Paper read before the Middlesbrough Section of the Institute of British Foundrymen. Mr. J. D. Smith, presiding. Mr. R. J. H. Ritchie is Managing Director of Messrs. J. and R. Ritchie Limited, Middlesbrough.

is like a motor-car valve, and allows the air to enter at full bore in the fraction of a second. The weight of the empty bogie, together with a ¼-in. hole in the air entry side of the charger, brings it back to the starting position in a few seconds.

A small pipe on the charger side of the valve leads to an air-pressure chart, which, together with the normal 24-hour chart of the air pressure in the receiver, gives a complete record of the weight melted, time and speed, and, in our case, the normal air chart also records every truck bearing coal, coke, sand, scrap or limestone coming up the gantry, with date and time, as is shown on Fig. 5. In Fig. 6 the normal air-pressure chart for September 26 last is shown, from which it is noticed that the compressor started just after seven o'clock, that two trucks of coke, one truck of sand, and one truck of scrap were unloaded in the morning, taking about 15 minutes for each truck, except that two trucks of coke were both unloaded in this time.

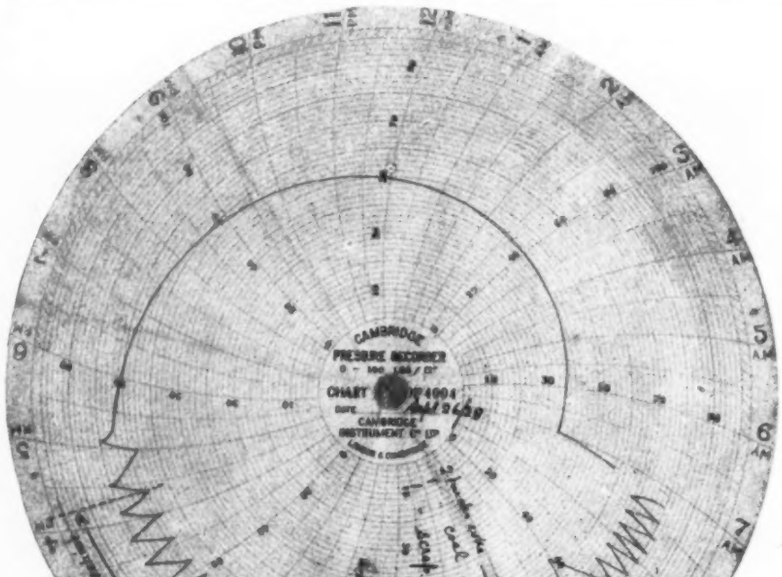


Fig. 5.—Charging Machine Recording Chart (Half Normal Size).

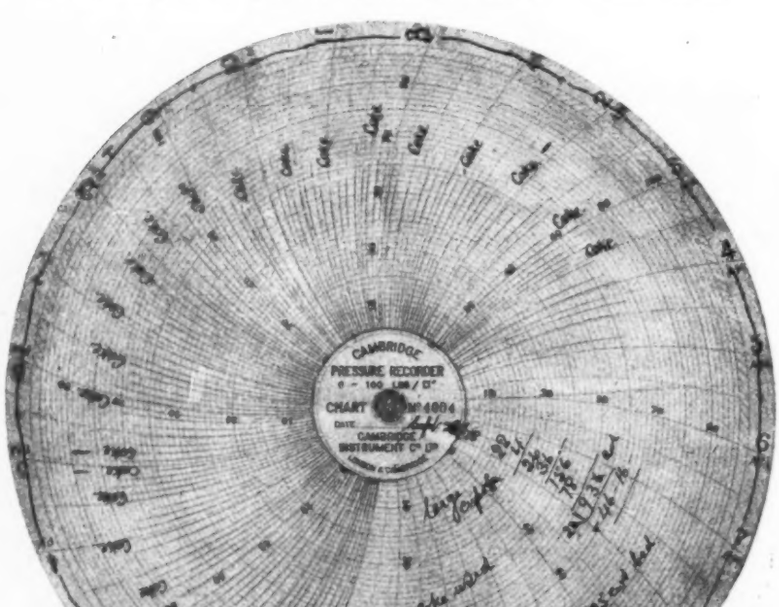


Fig. 6.—Air-pressure Chart (Half Full Size).

Any purchased scrap is bottom dropped like coal from the gantry. Two trucks of coal are generally hauled up the gantry by the air winch at one pull.

The chart shows the operation of the cupola demonstrated by small irregular waves in Fig. 6 between 12.15 and 4.15, the coke charges being generally observable on the detail chart, on account of the shorter lines through lighter weight. Every fifth charge is coke, except that two coke bogies are tipped about two o'clock, one after the other, to give super heat to the metal half an hour later.

The capital charge of the conversion from the old haphazard methods to absolute control were the cost of the weighing machine, seven bogies, making the charging machine, and buying the valve, new charging doors, a gangway at the back of the lift on the platform level, and a pressure recorder—a very small capital expense.

The saving obtained is one charger's wages (and a lighter job for the other one) over the last few months, and control of the metal at the charging door, and, therefore, at the spout, with consequent advantages.

The charts over the last few months show melts averaging 50 tons per day, with a coke ratio of about 9 per cent. running and 11 per cent. total, including bed, and no trouble has been experienced either with the charging plant or the quality of melt.

Bean Cars, Ltd., Appoint New Director.

Mr. Noel Martin, who has recently been appointed managing director of Bean Cars, Limited, joined them as director of sales and export six months ago. Mr. Martin was apprenticed to Marshall Sons & Company, of Gainsborough, going subsequently into the works of Roses, also of Gainsborough, who were then building the 18 to 22 h.p. three-cylindered National car, which was quite a notable machine in the early years of the present century.

After some years in the United States, studying intensive production as it then was, Mr. Martin joined the Studebaker Company, in London, remaining with them until the outbreak of hostilities, in 1914, when he obtained a commission in the Navy. In 1916 he was invalided as unfit for further duty, but got fit again, joined the R.F.C., and was in due course transferred to the R.A.F., eventually being demobilised—after service on all the European fronts—with the rank of major. He then joined Maxwell Motors, Limited, as general manager, was appointed sales director of Chrysler Motors, Ltd., when that company was formed, and remained in charge of Chrysler sales until, in February, 1928, he resigned his directorship. Next joining the board of Bean Cars, Ltd., as sales director, he went to Tipton to reorganise their sales policy and programme, as regards both cars and commercial vehicles, to such purpose that in January, 1929, he was appointed managing director of the company, in succession to Mr. H. Kerr Thomas.

The Bean Company have now in operation a very complete programme in both home and overseas markets, and are relying on that programme, and on Mr. Martin's connection of the past twenty years among both owners of and agents for motor vehicles of all types, to secure for Hadfield-Bean cars and trucks a considerably extended business.

Within a month after celebrating his golden wedding, the death has occurred of Mr. Alfred Edward Severn, one of the best-known figures in the industry of Derby. The deceased, who lived at 50, King Street, Belper, was 72 years old. He was apprenticed to moulding, and subsequently worked for the Park Foundry, and finally for the L.M. & S. Railway Company for 48 years.

The Keeping of Foundry Costs.*

A meeting of the West Riding of Yorkshire Branch of the Institute of British Foundrymen was held on January 5, at the Bradford Municipal Technical College. In view of the fact that the President of the Branch (Mr. W. G. Thornton) was to give the Paper of that day, the chair was occupied by Mr. A. S. Worcester, of Huddersfield (Vice-President).

The President of the West Yorkshire Branch Mr. G. W. Thornton) read the following Paper:—

The objects of any cost system or cost accounts are primarily to show (1) the prime cost or cost of production, so that the founder may know either there is profit or loss on the article or job, or, if not sold, the selling price he should charge; (2) the analysis of such costs, for instance (cost of moulding, core making, fetting, material etc.). The secondary objects are: (1) To obtain reliable records of work done for future reference; (2) to detect waste of material, and loss of time; (3) to act as a check on both the men and those in charge; and (4) to enable monthly or other periodical returns to be prepared to show the progress of the business.

Only by means of some system of cost records can the manager of any concern put his finger on the weak spots in the administration, and only by the use of cost records can orders be obtained in the face of keen competition, and, again, only in cases where cost records are available can it be determined whether or not a profit has been earned on any particular job. Cost records are files to which reference is made for information upon every question which arises in connection with any job.

The chief difficulty in costing is to frame or put together a system applicable to the particular requirements of the undertaking concerned, for although the general underlying principles are always the same, yet the special needs of any two businesses are never alike, the method of working never exactly the same, and the general organisation never on parallel lines.

Each undertaking must be considered on its own merits, and the wide differences in the methods of manufacture employed appreciated, the special circumstances of each case demanding special treatment for each.

It is not proposed to outline a system which covers all the points enunciated, as that would take too long. But a simple method, which will help practical foundrymen to know what is going on inside their own shop, and one which will provide in time with records of costs which they will find, if they have not already that information, very useful.

In a moderately small shop, with, say, 15 to 20 moulders, with the help of a youth, one can do this for oneself. Assuming that time cards, or some method of recording the men's time worked on the job exists, for if not one will have to obtain this information by some means, as this is the starting point. In this case one would require some cards printed something after the manner shown on card A, on which one can allocate the men's time on the job. Moreover, there must be provided a suitable box, or cabinet, in which to file these, so that one can put one's finger on any particular one which needs to be consulted at any moment; the method of filing can be either alphabetically, or any other suitable means.

This card (A), when completed, gives the cost of that particular job in hours per cwt., which it is considered is all that works or foundry office requires. It has been found that keeping the records of the labour cost of production in this form was very simple and convenient. One of its chief advantages is that it is a comparative record for all time, whereas if it is put into money value at this stage, and it is desired to compare this cost with some other, say, in a year or so, it is quite possible that in the meantime, the rate of wages will have been altered, in which case a further calculation would be necessary to make the two costs under consideration comparable. If at any time it is necessary to know the price per cwt., all one has to do is to refer to the record card for the particular job under consideration, from which is obtained the labour cost per cwt. in hours, and multiply this by the wages rate per hour, add establishment charge, plus cost of material, which gives the cost of works.

It will be found that after a period that some means of grouping the costs of the case casting made at different times together will be required, so that they can be compared at a glance. It is very important that one should have some means of doing this, and for this purpose a card B printed in the form shown should be provided. This card can be designed to accommodate as many records as may be considered necessary. All the information for this card is copied from the previous card (A).

Any alteration in the method of production should be noted. One should now be able to appreciate the use this simple system will be after it has been in operation some time, and a range of records has been established. For instance, a firm telephones for the price of a pipe, and the office gets in touch with the foundry for the labour cost; without any thinking or any calculation it can be provided with this information by simply referring to the records. A few seconds is all that is required, whereas if you have to sit down and calculate the cost it would most likely take anywhere from 10 to 15 minutes.

CARD A.

Date, 5/1/29.	Description.	No. off one.			File under.		P.
5/1/29.	9 in. Straight pipe with branch.				Order No.		287
Men's Nos.	Men's Names.	Hrs. in week ending.			%	Total.	Remarks.
		5/1/29.	12/1/29.	19/1/29.	Hrs.	Hrs.	
19	Taylor	2	5	—	—	7	
24	Brook	—	5	—	—	5	
Date finished.	Weight.	Cwts.	Qrs.	Lbs.			Hrs. per cwt.
14/1/29	—	4	2	0	Total ..	12	2.7

CARD B.

Date, 5/1/29.	Cost Record Card.			File under.
	9 in. Straight pipe with branch.			P.
Order No.	Date.	Men's Nos.	Hrs. per cwt.	Remarks.
287	14/1/29	19.24	2.7	—
315	30/1/29	19.30	2.5	Box in shop ready for starting.
390	2/3/29	19.24	2.7	—

Establishment Charges.

This embodies the following:—Interest on capital; depreciation of plant, tools, etc.; unproductive labour; repairs to machines or plant; paid salaries and office expenses.

Establishment charge or "on cost" may be defined as, the amount to be added to the prime cost or cost of direct wages, material, etc., to provide for "dead" charges. It is always a difficult matter to fix upon some basis whereby such expenses may be properly allocated to the various jobs. In the first place, the actual amount of these charges can only be determined after the end of a financial year.

As this is purely a matter for the office side of the business, it is not proposed to carry this part further except to insist that once this charge has been ascertained, it must be given to the foundry in such a form that it can be readily attached to the prime cost without undue calculation. There are various methods in which this can be done:—(1) As a percentage on prime cost; (2) as a percentage on cost of labour; (3) as a fixed sum for each hour worked; and (4) as a fixed sum per unit of weight (say, per cwt. of good castings produced).

In the author's opinion, No. 2, that is a percentage on cost of productive labour is the most suitable, and he will proceed on this basis. For the purpose of example this establishment charge will be fixed at 150 per cent.. This will enable us to proceed a step further with the building up of the cost, for taking from the record card the productive labour cost of 2.7 hrs. we have to multiply this by the moulders' rate of wages, say, 1s. 3d. per hour. This makes 3s. 4½d., to which is then added 150 per cent., which equals 5s. 0¾d., plus the original 3s. 4½d., which now equals 8s. 5¼d. To complete the cost there is still to be added the cost of the material. This is another charge which can only be determined by the office staff. In this case it will be defined as metal melted, and it is suggested that this charge or cost includes the following:—Metal, including pig-iron, scrap, etc. (including melting loss); coke; limestone; ganister; cupola bricks; moulding sand; cupola men's time; and the cost of all the power used in connection with the foundry. Of course this cost will vary considerably according to the class of metal being produced, and to a great extent the amount of metal being melted per day. It is suggested that a price be established for each of your mixtures. It would be foolish to try to analyse this cost, as the conditions and practice in foundries vary considerably, but for the purpose of the example, and to enable one to complete the cost it will be assumed that this is fixed at 7s. 6d. per cwt. Therefore a further step can be reached by adding this to the previous calculation, which now brings the total to 15s. 11½d. The only thing still necessary to consider is fettling or dressing. Most firms consider this as unproductive labour, and include it in their establishment charge. But the author prefers to make a separate charge of this. The cost of fettling is very easily ascertained by taking the fettlers' wages for a certain period and the weight of the castings into cwts. produced in the same period, as it provides two

* A discussion held under the auspices of the West Riding of Yorkshire Branch of the Institute of British Foundrymen.

figures, which when divided will give the cost per cwt. For the example it will be assumed that this has been worked out and found to be 6d. per cwt. plus on-cost at, say, 100 per cent., equals 1s. per cwt.

This last item completes the cost on works. The only other factors to consider are cartage and profit, but these do not concern the practical foundryman very much, so far as this Paper is concerned. For the purpose of grouping the cost together, that is the finished cost, including material, establishment charges, etc., it is suggested a card, something on the lines of the one shown at (C). This is intended for office use only.

It is conceded that there are still a great many points which have not been touched upon, but there are sufficient for discussion.

Card C.—*For Office Use Only.*

Date.	Foundry Item Cost Card.						Order No. 287.
14/1/29.	Description.—9 in. Straight pipe with branch.						
Week ending.	Men's Nos.	Hrs.	Wages rate.	£ s. d.			Total item cost.
5/1/29	19	2	59/–	0 2 6	Cost		£ s. d.
12/1/29	24	5	59/–	0 6 3	On works		3 15 9
12/1/29	19	5	59/–	0 6 3	Carriage		0 2 3
					Total		3 18 0
					Price received		4 10 0
Totals..		12	—	0 15 0	Profit		0 12 0
Est. charge at			150%	1 2 6	Loss		—
	Cwts.	Qrs.	Lbs.				
Weight.. ..	4	2	0 at	7/6			
Fettling at				1/0	0 4 6	Price per cwt. received..	1 0 0
						,, ,, cost ..	0 16 11¼
Total cost on works					3 15 9	Profit per cwt.	0 3 0¾

DISCUSSION.

The Chairman (Mr. A. S. Worcester) said there was no doubt this matter of costings was a most important one; probably the most urgent matter in the foundry world to-day. If Mr. Thornton's excellent paper might help the industry to hit upon a system which could be adopted generally he would have done a very great service indeed. Many foundrymen to-day, without a doubt, were turning out castings without a full and proper knowledge of the costs of production.

A Wider Interest Essential.

Mr. H. Burnley (Bradford) said he thought it would be extremely valuable if all the foundry owners in the North of England could be invited to a discussion on costing in the industry. Indeed, he felt that in some cases it might be well if they could have a discussion on the subject about four times per year. It was a matter on which only too many people in the foundry industry knew too little about. As a sales engineer he had come up against cases of price-cutting which were astonishing, and which would probably be still more astonishing to the producers if only they could know the full extent of their costings. Mr. Burnley gave instances of work accepted at about 12s. per cwt., which, if properly costed could not profitably be taken at less than 20s. or 22s. Probably not half the foundrymen of to-day knew within a wide margin per cwt. what a job was costing, and a policy of cultivating a knowledge of this important subject would be of inestimable benefit.

Allocating Cost of Small Supplies.

Mr. W. Parker (Sheffield) asked what allowance Mr. Thornton, in his costings, made for materials. Were they taken in establishment charges—say, proportionately on a job? He was speaking of the ordinary requisites used on the works, and he did not see any place in Mr. Thornton's figures which seemed to include this item, unless it was in the establishment charges. Personally, he felt that materials should be quite a separate item in costing, especially in relation to some jobs which required a quantity of chaplets, studs and other rather expensive items. He was not, of course, referring to things like sand, blacking, etc.

Mr. Thornton said he was prepared to admit he had overlooked such matters as chaplets, etc., because in his own work he was not now troubled with them. His metal charge included all sand and material for the cupola and all the core-material in the foundry. Studs he would put into establishment charges. If one was to try to allocate separately the amount of studs put into each job it would make a complicated system, whereas his sole idea in this matter was to produce as simple a costing system as possible, subject to its furnishing information which would be helpful to the man in charge of the foundry work. The system he advocated had been introduced by himself when with his former employers, a very extensive firm, and it was such that a boy clerk could get him the cost of a job quickly without his having to wait for the office staff to work it out.

Danger from Over Detailing.

Mr. Parker said what made him ask the question was that he had in mind a large firm in another district, whose practice was to have everything weighed out and charged up against each job separately. Even if the item were one stud or a ¼-lb. of sprigs, it was charged up, and nothing was supplied except for what the foreman could produce a requisition. The firm knew exactly what every job cost in materials and, being a large undertaking, they saved a great deal of money by that careful method. Perhaps such close checking of materials was not so very important with a smaller firm.

Mr. Thornton said the greatest danger in adopting a system of costing was that one might adopt so complicated and perfect a system that the costing process was going to cost more than the value of the job. A split pin that cost a halfpenny could cost a good deal more than that in collecting and recording of it if one was not careful to avoid getting down to too close a system. He (Mr. Thornton) assumed that the meeting was a meeting of foundrymen, concerned not so much with the last farthing as with the desirability of knowing, as soon as possible after a job was finished, whether it had made a profit or not, so that, if necessary, steps could be taken in regard to the next job of the kind.

Mr. Burnley spoke of the danger of overdoing costing, at needless expense, in a foundry doing a good deal of repair and renewal business for, say, textile machinery users—all kinds of jobs often wanted in a hurry. An elaborate system of costing on every job of that kind would be more expensive than it was worth.

Weight Basis Queried.

Mr. A. S. Worcester said he regarded the record of hours per cwt. as one of the most valuable factors in the costing system suggested by Mr. Thornton. The card "A" was a simple means to enable the shop foreman to keep trace of his actual cost in hours per cwt. He thought perhaps the best way of dealing with establishment charges was a proportion on the selling price. An establishment charge, of course, could only be arrived at accurately by taking at least a year's working, and perhaps even better was to take over a period of, say, five years. In regard to the matter of materials, in something a dozen foundries with which he had been associated he did not think they had put down a proper proportion for shop scrap. In checking over shop scrap at the year end, even when allowing for above the average melting-losses, he had never seen a balance struck on price. The shop scrap was the dearest material because it was carrying much unrecorded charges. In any system of costing, thought Mr. Worcester, surface and thickness were the factors that counted, this applying in the foundry equally as on the engineering side. Surface had to carry facing sands, blackings and everything else, and he thought thickness multiplied by surface was the only accurate way of getting at the costing. These factors would cover practically everything.

Differentiating Heavy and Light.

Mr. Thornton said he quite agreed with the observations of Mr. Worcester. If he had a small shop and a big shop section, if the office gave him a figure as the result for the last financial year he did not say he would necessarily put 150 per cent. on the big job entirely. He might dissect it and make the small carry rather more and the big carry less. There were, of course, always likely to be cases which carried more and some which carried less than was needed.

Mr. Worcester said he thought it was better, instead of carrying establishment charges on productive labour, to give either actual cost or selling price.

Frequent Review Essential.

Mr. Parker questioned the figure of weight charge; but Mr. Thornton replied that that was essentially a figure which must be subject to review and revision periodically—perhaps every three months or so—because of variation in buying charges.

Mr. Turner (Elland) said he saw much good in the proposed system for firms doing a good deal of work, but he hardly saw how a little firm—particularly a man starting a shop, with nothing to refer to except his own judgment—could very well come to a fixed sort of price.

Materials as Overheads.

Mr. R. D. Welford (Bradford) said it seemed to him that Mr. Thornton had given a very clear and concise method of foundry costing, and one which he felt could probably be worked successfully in almost any foundry by any intelligent man who had any knowledge at all of book-keeping. Mr. Thornton, of course, had given imaginery instances of jobs, and he certainly, in his imagination for the purposes of the Paper, was running a nicely prosperous concern. If all foundry proprietors could be sure of a profit of 3s. per cwt. on the average they would not be doing too badly. The "A" and "B" cards were of the greatest value to the foundry manager and foreman by supplying a clear index of the time spent on each job, for ready reference, instead of the man responsible having to keep any kind of a notebook of his own with a view to future reference. Mr. Welford expressed himself entirely in agreement with the suggestion that "hours worked" was the only true guide for the foundryman. The third card suggested by Mr. Thornton was, of course, more an office matter than one for use in the foundry itself. Mr. Welford's own personal opinion was that the labour cost, the metal charges and the materials charges should be separate. As to whether one should charge all the materials to every job, it was a very debateable point. A man may not know exactly what chaplets, for instance, he needed until he had got his thickness, and ultimately he may have some left over. If all taken out were charged up there may ultimately be a little profit on what was left over. Undoubtedly, said the speaker, the crying need of the foundry industry to-day was for a unified costing system. The National Light Castings Association had a national costing system which was operative in all works identified with that body, and was checked by the association auditors. The prices of the firms connected with that body, also, were standardised. In the foundry trade there was too much price-cutting, and very often the man who got a job, if he actually knew by proper costing what the job cost, would find that he was making a loss on it. It was one of the blots on the foundry trade to-day. If proper costings were known, and a proper price based on such knowledge, the foundry trade as a whole would benefit, and, incidentally, the people em-

ployed in the industry would benefit because the employers would be in a position to pay a better rate of remuneration. It would be very helpful, even for a small foundry, for a man to get his overhead charges worked out, by an accountant, if necessary. Mr. Welford thought a system of never selling all castings by weight would be very desirable. The value of this had been instanced by Mr. Worcester in his mention of the balance weight or hammer block, which did not take up the floor space of a light casting much less in weight. Another way was to take the total metal melted and average it, and charge the cost per cwt. of metal melted and the difference between the price of the metal melted and the scrap value, against the casting. If one charged the difference between weight used on the average and the rest cast back at scrap values one kept one's metal melted charges always at the same market price. Mr. Welford said he was sure the system which had been outlined by Mr. Thornton was a very simple and good system which did not go into too many details and too many sheets to make it impossible for the average man to work it, or to demand the services of an accountant or an office full of clerks to work it. He moved a hearty vote of thanks to Mr. Thornton.

Materials Should be Separately Costed.

MR. J. WATSON (Huddersfield), seconding, expressed the view that it was desirable to separate productive material and unproductive material. The rent, rates and similar overheads should, he agreed, come into the "on" charges, but he did not believe in taking foundry materials into the "on" charges.

MR. THORNTON said that was the attitude he had himself adopted. His figure of 7s. 6d. includes materials, but the scheme was designed to be as simple as possible. If charges were up because of slackness of trade or other causes, then due allowance must be made in the costing, up or down, but it was well if one could strike an average as far as possible.

Object of the System.

A MEMBER: Is the system based on each individual job or per day?

MR. THORNTON said the scheme was on each job, but members must use their own judgment as to how far they adopted the system or modified it. The whole object was to tell a man quickly what a job was costing and whether it was paying or not. There were undoubtedly foundries taking work at prices at which they must be losing money, even though, for lack of a good costing system, they did not know it. By his system, said Mr. Thornton, he could tell the day after any job was cast, what it had cost, and if he found he had to get a better price or it was impossible to make it pay, he knew what to do when asked to do a similar job on another occasion.

Raw Material Costing.

MR. H. FORREST (Bradford) said his firm were working a system something on the lines suggested. They took the total cost of pig-iron and yard scrap for a year and divided into the total tonnage of castings produced over a year. All sand and foundry materials were booked in with the administrative overhead charges. The "on" cost was taken on a percentage of productive time, and the fettling and metal. The metal cost was metal and the melting cost. If there was any slump it must be allowed for in increasing the "on" cost.

Reticence Causes Misunderstandings.

MR. STEPHENSON (Bradford), a visitor, who said he had had some experience as a cost accountant, said he quite agreed with the lecturer that what was needed was a standard method of costing so that real comparisons could be made. He felt that lack of knowledge of costing was largely the foundry managers own fault to-day. As one who spoke from the business side, he thought the average foundryman was inclined to regard with impatience, and perhaps too much suspicion, the young clerk who came along from the office for information. The foundryman seemed to regard the clerk as one attempting to show him a job he had learned from boyhood. The trouble was, Mr. Stephenson admitted, that nearly every case on which questions were asked of the foundryman was one on which a loss had been shown and the administrative chiefs wanted to know why. Usually nobody bothered to make inquiries about those that showed a profit. Therefore, as soon as the foundry manager or foreman saw the clerk coming he suspected trouble, and looked on the man who was sent to collect costings as a probable critic. That should not be the case. If the foundry manager or foreman would recognise that the cost clerk was one with whom he should co-operate, many difficulties would disappear, especially in regard to administrative "on" cost. On the "on" costing sheet, illustrated by Mr. Thornton, it was to be seen that whatever saving the foundry may make in methods of production, it did not lessen the cost by anything like that 150 per cent., or whatever the figure may be. Unless the foundryman understood fully what that figure meant—a matter over which he had no control and over which he was not expected to have any control—he was liable to feel the figure nullified any savings he may make. The foundry manager had a right to insist, suggested Mr. Stephenson, that he should not be brought up and criticised on total figures unless, of course, he had full control of total figures—which in most cases was hardly likely. It was essential that the foundry manager should know the cost of castings going out of the foundry door and—in most cases—no further. For that reason he (the speaker) did not agree with that figure of 150 per cent. The lecturer had mentioned interest on capital. Personally, he did not believe even foundry managers, anxious as they were to make a success of their job, expected to get two profits. Interest on capital was a profit, and, to his mind, had nothing to do with this matter of cost of production. He did not think an assumed interest on capital should be put into an illustration of a costing so far as concerned the cost on production. Mr. Stephenson said he thought the method mentioned by Mr. Forrest, on the metal-melting cost, was an excellent one. He certainly agreed that foundry managers and foremen could gain much by a closer knowledge of costing; that they could achieve a great deal by a closer co-operation with the costing clerk; and that if a system were found to be too elaborate, much unnecessary detail could be cut out and the system simplified so far as concerned the foundry.

Interest on Capital.

MR. THORNTON, replying, said he made no claim that the system he suggested was worthy of a cost accountant. It was designed for simplicity in use in the foundry, and, so far as the foundryman was concerned, it checked the cost accountant's figures and gave information which served a very valuable purpose within his own actual experience. In regard to the doubts raised on interest on capital, Mr. Thornton said he did not think any costing system would be found that did not include that item. It was an item that existed and had to be allowed for. He admitted it was a debatable point so far as concerned a costing actually for the foundry, but capital certainly demanded an interest, whether it were in a works or in the bank. Personally, he felt that a costing system, to be reliable and helpful, ought to allow for that interest. Mr. Thornton said he entirely agreed with the suggestion of better co-operation between the foundryman and the office staff. If the office staff could get all the information they required from the foundry manager or foreman, they were the better able to compile accurate statistics, instead of having to put down figures that they think will meet the case because they were unable to get the actual information from the proper source.

Busy and Slack Periods.

MR. STEPHENSON, commenting on observations as to the relationship of costings to busy or slack periods, suggested that it was wise, as far as possible, to try to obtain a fairly normal working year—ignoring abnormal times when busy or slack—and base costings on the normal state of costs, because, after all, the normal year was what they expected and hoped to have.

MR. WORCESTER, closing the meeting, said the branch was very fortunate in having an enthusiastic president like Mr. Thornton, able and willing to bring up for discussion something original and important. The Paper, he was sure, was an honest endeavour to help the average small foundry to keep a check on costings, and Mr. Thornton had himself proved its efficacy.

British Facilities for Foundry Training.

No. VII.

BY P. FOX-ALLEN (Associate Editor of THE FOUNDRY TRADE JOURNAL).

Manchester College of Technology.—Metallurgical Department.

Mr. E. L. Rhead, who is in charge of the Metallurgical Department of the Manchester College of Technology, has long been an ardent advocate of the higher education of the foundry apprentice. It is, we believe, about 5 years ago since he brought this question before a meeting of the Institute of British Foundrymen. This was at a time when a scheme for extending the buildings and facilities of his college was under consideration.

Mr. Rhead inclines to the view that it is preferable for the foundry student to enter the technical college before he has had any works experience, entering the works with an entirely open mind he may easily acquire wrong ideas in many important essentials, and obviously those ideas must be dispelled as a preliminary to a technical education; in a word, it is better for master and student that the ground to be worked should be virgin. At the same time Mr. Rhead emphasises the necessity of the technical and practical sides of the work being conducted conjointly.

His suggested scheme provided for an experimental foundry being attached directly to the Metallurgical Department. The equipment of such a foundry could not, indeed, must not, be commercial, the melting plant and, in fact, the whole of the auxiliaries would have to be constructed in such a manner as to lend themselves to various modifications in order to enable practical work to be done under widely varying conditions.

Mr. Rhead had secured the co-operation of several local foundries who were prepared to send patterns, and to allow of the molding and casting operations being made under the supervision of one of their own skilled men—the firms in question to have the option of purchasing the castings made at the actual cost of the metal, Mr. Rhead pointing out that such an arrangement would maintain the interest of the students and furnish them with an incentive to produce good work, such as is wholly impossible when producing castings for educational purposes only, and to re-melt them as a matter of course.

Unfortunately, however, for the realisation of Mr. Rhead's ideal, the scheme for extension was shelved. The extensions to the buildings have now been sanctioned, and the work will shortly be put in hand, and it may be that adopting the broad principle of Mr. Rhead's suggestions Manchester will be the first of our educational centres to provide the higher practical and technical education of our future foundrymen.

In the meantime, however, the small foundry at the Manchester College is attached to the Engineering Department, and Mr. Rhead's activities are confined to work of a purely metallurgical character. Very liberal accommodation has been provided in the Metallurgical Laboratory, and the equipment includes a fine bank of furnaces, consisting of a Carr furnace for melting iron; twelve independent-wind furnaces, in these iron can be brought down; six muffle furnaces and four gas muffles. The whole of the furnaces exhaust to a common flue, the draft being supplied by a 60-ft. chimney. Students' benches are ranged parallel to the line of furnaces, and each bench is furnished with a set of re-agents. There are two small experimental electric furnaces and a motor-driven pestle and mortar. The metallographic equipment consists of various microscopes and a full Leitz equipment of the best type.

XUM

Patternshop Standardisation.

By J. McLachlan.

Wherever there are two or three foundrymen and patternmakers gathered together the subject of the quality of patterns is sure to be discussed, and bad castings are quite often traced to unsatisfactory patterns. Sometimes, indeed, the patterns are blamed for inferior castings when they have had no influence whatever on them. In standardisation schemes for engineering works, the difference between patternshop standardisation and foundry, machine and fitting shops is that while for the patternshop standardisation means a uniformity of materials and workmanship in the foundry, fitting shop, and other departments processes are standardised. Only in a very modified way can it be applied to patternshop practice.

Considerable publicity was given some years ago to the need for standard thicknesses and widths of timber used in the patternshop, in addition to the quality of the work. It is difficult to see how the use of standard thicknesses (except for some skeleton patterns) and widths of timber would affect either the price or the quality of patterns. It is usually found economical to have timber in the shed from ¼ in. thick up to 3 in. thick, and a considerable waste is caused when, as in some shops, only thick timber is stocked, which has to be reduced for other thicknesses. What invariably happens when a patternmaker wants 2½-in. timber, and only 3-in. is available, is that he planes ½ in. from the thick timber. Some careless workmen will even plane more than this rather than use the circular saw With regard also to widths, it is economical to stock various widths of the same thickness, otherwise much strip timber is cut to waste. Even, as in some patternshops, when only one thickness of timber is purchased from the sawmill, it is good practice to have it ripped into varying thicknesses by the machinist before it is racked in the timber shed.

Jobbing Pattern Shops.

Jobbing patternshops—or, as they are sometimes called, master patternshops—are generally run on more economical lines than shops attached to engineering works, and they are frequently able to quote prices for their work that are actually lower than those of an engineering works' own patternshop, although there must obviously be a profit margin on their prices. One way by which they keep production costs low is by careful buying of timber; in some cases two qualities of yellow pine will be stocked, and frequently purchases are made of what may be termed job lots of timber. Also a more accurate record is kept of the timber used for different jobs. Timber leakages are not now as common in any patternshops as they used to be, because of modern costing systems. In nearly all patternshops it is advisable to have two grades of yellow pine in addition to baywood or some other hard wood for special work. Timber that has many knots or a number of wind shakes is not suitable for high-quality patterns or those on which much carving or shaping has to be done, but it is quite good enough for cheap one-off patterns and skeleton work that may never be required after the castings for which they have been made are passed. It is, of course, foolish to have different grades of timber in the same rack. There should either be two separate racks, or, better still, the good-class timber should be in a special shed to which only the foreman has access.

Use of Standard Timber.

One writer on standardisation, with evidently a very imperfect knowledge of engineering works practice, has suggested that the works drawing office should design patterns to use standard timber, while the grade of timber is specified on the pattern drawing. This writer speaks of the grade of timber as being (1) mahogany, (2) oak, (3) pitchpine, (4) yellow pine, etc. It is rather ridiculous to grade timber in this way, because these are various kinds of timber and not qualities of timber. Further, it would be quite impossible for any drawing office, either in a works where repetition castings are made, such as the motor-car works or a shipbuilding yard, where the majority of the patterns are of the one-off kind, to stipulate the kind or quality of timber to be used in constructing patterns. The foreman of the shop is in a better position to decide what kind of timber to use, and also the class of pattern that should be made. While, as a general rule, plate patterns and small standard patterns, such as valve mountings, can profitably be made of hard wood and one-off patterns of yellow pine, yet there are occasions when it is wise to use hard wood for a one-off pattern. Before the drawing office could reasonably stipulate the kind of timber to use they would have to decide whether a shell pattern or a block pattern or a skeleton would have to be made, and there are very few drawing offices who could make such a decision as well as the foreman patternmaker.

It has been suggested at various times that workmanship and finish may conveniently be designated by letters: A, the best; B, good; C, cheap finish; D, rough pattern straight from the saw and sanding machine. We do not know of any patternshop where it would be practical to grade the patterns and coreboxes into four different classes, and in nearly all cases it is sufficient to have two different classes of patterns. Even when different classes of patterns are made it is seldom that there is any hard-and-fast division. The foreman in most cases instructs the patternmaker to make a rough job, probably butt jointing timber, fastening loose pieces with sprigs instead of dowels or dovetails, and simply painting fillets and leaving the moulder to cut them in the sand instead of carving them from the timber or using leather filleting. Very often the foreman will say, "Make a good job of it, because there will be twenty off," or, alternatively, "It is a one-off job, therefore do not spend much time on it." In shops where much of the work lends itself to the skeleton method of construction the foreman may instruct a man to make it either skeleton fashion or solid, and will probably also state whether he wants full solid coreboxes or part coreboxes and strickles. By leaving matters like these to the foreman, patternmaking costs are kept low. It is only fair to state, however, that even without specific instructions from a foreman or charge hand the average patternmaker will exercise his own common sense and will make a pattern that is most suitable for the purpose for which it is required. No skilled craftsman would take pleasure in making a costly standard pattern for a one-off job, and it is sufficient for the drawing office to record on the drawing the number of castings that will be required.

Patterns to be Painted.

Ordinarily, the quality of the pattern will decide whether or not it should be painted, but it would be foolish to standardise patterns, as those that are painted and varnished and others that are painted only, cheap painted or without either paint or varnish, because sometimes patterns that are made without fillets or high-tool finish are painted. Then, again, where the metal is thick, or the castings are of the sash-weight order, a high finish is not necessary, but as the pattern will probably be required over a long period, and hundreds of castings will probably be made from them before they are discarded, it is wise, if not absolutely necessary, to paint and varnish them. It is very seldom nowadays that ordinary paint is used for patterns without subsequent varnishing; in some shipbuilding yards patterns may either be unpainted or painted only, and, of course, the factor to be considered is whether they are coated simply to protect them, or to protect them and also to facilitate their withdrawal from the sand. After a pattern has been used for a time, unless it is protected from the damp and heat by paint and varnish, side grain will shrink, and this may mean the tearing up of the mould, with the necessity for much patching. Because of this, a protected surface is a great advantage, and there is also the important factor that a smooth and glossy pattern delivers from the sand much better than one with the grain of the wood exposed.

Sandpaper is used often in patternmaking when it is quite unnecessary. Generally speaking, one-off patterns and coreboxes do not require to be sandpapered, and the spokeshave will in many cases make a better finish and one more quickly done than when sandpaper is used. It is admissible, and indeed almost advisable, that there should be a standing shop instruction not to use sandpaper unless for repetiton work. Fortunetely, in many patternshops now, the sanding machine does work that was formerly done by spokeshave and ordinary sandpaper.

Standard Core Boxes.

Standard coreboxes ought certainly to be used wherever possible, but in jobbing shops it is only possible to standardise coreboxes for straight round cores. It does seem superficially that for oblong and square slab cores standard coreboxes could be used, but these can be so quickly made in modern machine-equipped patternshops that there would be no gain of any kind by doing so. Even in repetition shops, in nine cases out of ten, when a new pattern has to be made, new coreboxes also have to be made. In one way standardisation could be adopted in patternshops where much skeleton work is done, and economy effected. We refer to the making of section pieces and joint plates. Some patternmakers will use timber 1½ in. in thickness for section pieces that could be equally as satisfactorily made from timber ⅞ in. or 1 in. thick. Also, in shops where much template work is necessary for which patterns are subsequently made, there should be a standing shop instruction that only one thickness and quality of timber must be used. There are very few purposes in a patternshop for which spruce is satisfactory, but in some shops it can be used up to a point, although it will not be used by most patternmakers unless they are compelled to do so. It is sometimes also possible to use driving nails instead of screws, and although they are seldom as satisfactory, except perhaps for building segmental work, they do cheapen production, and there is no reason why they should not be often used in the construction of skeleton patterns.

Iron and Steel Production in Canada in 1928.

During 1928 the production of pig-iron and primary steel in Canada reached the highest level attained since the record year of 1918. Output of pig-iron at 1,037,535 tons of 2,240 lbs. was 46 per cent. greater than the total of 709,697 tons in 1927. The 1928 output included 724,561 tons of basic iron, 233.136 tons of foundry iron and 791,838 tons of malleable iron.

As almost 70 per cent. of the Canadian pig-iron goes into the manufacture of steel, this gain was reflected in the production of steel ingots and castings, which at 1,240,214 tons was 37 per cent. over the 907,638 tons reported for the previous year. Increased demand for rails, track equipment and rolling stock by the railroads was one of the principal factors contributing to the gain in steel production. Other stimulating factors included greater requirements from the construction, the automobile, the agricultural implement and the mining industries and power development enterprises.

Iron and Steel Output in January.

The National Federation of Iron and Steel Manufacturers report that the number of furnaces in blast at the end of January was 139, a net increase of 7 since the beginning of the month, 8 furnaces having been blown in and one having ceased operations during the month. The production of pig-iron in January amounted to 563,900 tons, compared with 540,400 in December and 560,500 tons in January, 1928. Last month's production included 185,500 tons of hematite, 226,700 tons of basic, 101,600 tons of foundry and 23,900 tons of forge iron. The production of steel ingots and castings in January amounted to 761,600 tons, compared with 683,100 in December and 626,200 tons in January, 1928.

Melting Practice in the Foundry.

By Henry M. Lane.*

The prime requisite of all foundry operation is properly melted metal. In grey-iron practice, two melting methods have been in general use: these are cupola and the air furnace. For many years the air furnace was relied upon to give a superior product, and much attention was paid to its proper operation and the control of the metal by means of test-pieces. This method is still used quite extensively for producing relatively large masses of uniform iron to meet high test requirements, and more will be said later about the process in connection with furnace design.

The cupola has been the main dependence of the foundry trade up to the present time. The fuel was originally semi-bituminous coal or anthracite, and later coke came into general use.

There have been many improvements in cupola practice, and a good cupola operator should have a knowledge of what chemical reactions take place in the cupola. The cupola is probably the most efficient furnace from a fuel standpoint that has been devised by man. The melting is done in direct contact with the fuel, which is usually coke. The descending charge is preheated by the ascending waste gases. The metal and the ash are all melted and run out in liquid form, the ash as a slag. In the case of short heats, the slag is sometimes held in the cupola, and allowed to flow out when the bottom is dropped at the end of the heat.

In cupola practice, it is necessary to introduce the air as a high-pressure blast, to overcome the natural resistance of the material in the descending charge. Originally, some form of fan was used, and the pressure that it could produce was limited, and this limited the possible height of the cupola. With the introduction of the positive pressure blower, cupolas grew in height, and there was a greater opportunity for preheating the descending charge and for saving of fuel.

Function of Bed Charge.

The bed charge in a cupola serves simply as a stage to support the rest of the material during the melting operation. The bed, however, must be brought to melting temperature at the beginning of the heat, so it will not have a chilling effect on the metal. When metal is confined in the cupola and subsequently tapped into a ladle, it is necessary to have storage capacity in the cupola, and this metal must be stored within the coke bed; hence, it is in an excellent position to take up sulphur or other impurities from the partially burnt coke of the bed.

The part of the bed below the tuyeres acts as a stage or support throughout the entire heat. The part between the tuyeres and the melting zone is the active melting ingredient of the charge, and enough coke must be added to it on each charge to compensate for the coke burned in melting each charge. If recourse be had to a forehearth or receiving ladle, the bed can be reduced to a minimum, and a decided saving will be made in coke. To understand coke consumption and coke savings, some knowledge is necessary of the chemistry of combustion. When the air enters the tuyeres, if the blast is properly proportioned, the oxygen present will all be burned to carbon dioxide gas, and this reaction will give off 14,500 B.T.U. per lb. of carbon burned. This also gives a maximum possible temperature, which is around 1,650 deg. C., and it makes possible the rapid melting in the melting zone.

Unfortunately, above the melting zone, the descending carbon, in the form of coke, becomes red hot, and a secondary reaction takes place, in which the carbon dioxide takes more carbon and becomes carbon monoxide. When one pound of carbon is burned to carbon monoxide it gives up only 4,450 B.T.U., or approximately 10,000 B.T.U. less than are given up when a perfect combustion takes place. As a consequence, the formation of carbon monoxide above the melting zone locks up heat and carries it up through the charge in the form of carbon dioxide. This gas burns at the charge door with a blue flame, much to the annoyance of those who must work on the charging platform. Many attempts have been made to reduce the proportion of carbon monoxide.

Wet Coke.

Nearly 30 years ago, the writer and Thomas D. West ran some tests on this, in connection with which the coke was damped, and by this means they were able to reduce the percentage of carbon monoxide at the charging door very materially; also, to their surprise, they saved coke; but when they came to investigate the matter, they found that they had simply prevented the waste of coke. The ascending heat was ample to expel the moisture and turn it into superheated steam. This, in turn, preheated the descending charge quite as well as would have been done by the dry gases.

In the past it has been quite a common practice to figure that it required 30,000 cub. ft. of air to melt one ton of iron. If one is arranging for maximum blower requirements, this is a safe figure to use; but it is a very wasteful figure, and is only arrived at in very poor melting practice.

In calculating the amount of air necessary for a cupola, it must be remembered that coke is not pure carbon, but carries approximately 12 per cent. ash; hence, at any given melting ratio, this must be taken into calculation in figuring the air requirements. If the formation of carbon monoxide could be entirely avoided, we would melt iron with about 22,000 cub. ft. of air per ton, but this figure is very difficult of attainment. In order to have figures comparable, the bed should be excluded from the calculations, and the amount of coke between charges considered as the actual melting ratio. In most fair foundry practice, this is taken as a ratio of 1 lb. of coke to 10 lb. of iron.

Fuel Consumption Affected by Type of Charge.

The amount of fuel necessary is also affected by the type of metal being melted. Where steel is added to the charge, there are certain chemical reactions going on as the steel descends through the cupola. Steel in the cupola becomes heated and undoubtedly takes up considerable carbon, first, from the carbon dioxide present, and, second, from a solid carbon. This case-hardening action is increasing the carbon content of the steel, and at the same time, reducing its melting temperature. If the entire charge is made of steel, it will pick up so much carbon in passing through the cupola that it is no longer truly steel but a low-carbon cast iron. In order to accomplish these results, it is necessary to maintain a very high temperature, and the result is a lower melting ratio; that is, more pounds of coke are necessary to melt a ton of iron than are necessary when a soft grade of iron is being melted and the charge consists entirely of scrap and pig-iron.

When cupola malleable is being made, a still higher temperature is required, and all of the carbon must be combined with the iron; the result is a still lower melting ratio, so far as pounds of iron per pound of coke melted are concerned. With the old-fashioned cupola, the main savings that could be accomplished resulted from a careful selection of the proper kind of coke and the wetting of the coke.

Engineers have approached the saving problem from several other angles, all of which looked toward the conservation of heat. There was a Frenchman by the name of De Clercy who brought a cupola to America 20 years ago, in connection with which he had an auxiliary wind belt two or three feet below the charging door, from which he drew a certain proportion of the products of combustion, and these he combined with additional air in the blower. His object was to dilute the carbon monoxide to such an extent that it would not burn or explode. The result was the pre-heating of the blast to around 93 deg. C. and the return of a very small proportion of carbon monoxide to be burnt at the tuyeres. His cupola did show very good savings, but it required a careful operation; and when the writer visited his foundry in Paris a few years ago, this cupola was not in use at the home of its inventor.

Oil Firing.

The next important step was taken by Bradley Stoughton in his attempt to substitute oil for a portion of the fuel in melting. With this arrangement, oil was burned in the auxiliary chamber and the product of combustion introduced through the tuyeres with a small excess of oxygen. This was introduced directly into the tuyeres with oxygen sufficient to burn the oil plus a small amount of coke. Theoretically this arrangement was supposed to give a higher temperature in the melting zone and to reduce the amount of coke necessary. With coke fairly high priced and oil at a low price, as it was on the Pacific Coast some years ago, quite a saving can be shown with this style of melting; but the difficulty was to maintain the rate of oil flow and the excess oxygen on one hand, and the amount of coke added to the bed on the other, so as to keep the bed at the proper height and avoid the oxidation of the iron. The nicety of the adjustment made it impossible to run this type of cupola with the same grade of labour that operated the ordinary coke-fired cupola, and this factor eliminated some of the plants, while the rising price of oil as compared with the coke eliminated others.

Powdered Coal as a Cupola Fuel.

The Whiting Corporation has recently been carrying on some interesting experiments in the use of powdered coal as a cupola fuel. In this case, the coal is burned in auxiliary combustion chambers outside of the cupola, and the products of combustion, together with a slight excess of air, are introduced through the tuyeres. As in the oil-fired cupola, the bed must be built up at a rate proportional to the excess of air introduced. Both the oil firing and the powdered fuel introduce one additional element into cupola practice, and that is the presence of hydrogen in the combustible gases, due to the presence of hydrocarbons in the auxiliary fuel used. This may not be wholly an unmixed blessing: on the one hand, the resulting components may break down to oxidise the descending charge, while on the other hand, the burning of the hydrocarbons certainly will prevent the excess of CO gas in an all-carbon fuel.

The Schurmann Cupola.

Many engineers have looked for some way to utilise the waste heat, and recently there has been put on the market a hot-blast cupola, which is turned out by the Griffin Engineering Company, and which was developed in connection with the plants of the Griffin Wheel Company. In this arrangement, an auxiliary air belt, similar to the one in the De Clercy cupola, is placed a few feet below the charging door, and a certain proportion of the products of combustion are extracted at this point; but, unlike the De Clercy arrangement, no attempt is made to return these products of combustion to the cupola. On the contrary, a practice similar to that followed in blast furnaces is resorted to, and the material exhausted is burned with the addition of a small amount of oxygen and used to preheat the blast. The preheating arrangement is known as a stove; the products of combustion from the furnace pass up through pipes about which the incoming blast circulates, and it is necessary to have an exhaust fan to take the products of combustion from the stove and blow them into the open.

This arrangement not only returns to the cupola a portion of the sensible heat present in the gases that have been exhausted, but also the heat made available by burning the carbon-monoxide gas exhausted. With this arrangement the blast is heated to from 204 to 260 deg. C. before it enters the cupola. This results in a more rapid combustion at the melting zone, and in a higher temperature at the melting zone; also, if one attempts to maintain the same temperature, it is necessary to burn less coke to accomplish the results; hence, there is a considerable saving in fuel, as well as the assurance of constant conditions in the melting operation. There is no reason why the hot-blast

* Foundry Engineer, Detroit. A Paper read before the Convention of the National Founders' Association, New York.

system above outlined cannot be combined with the General Electric Company's control of the ingoing air,* and this should result in very efficient cupola practice.

Development of Special Furnaces.

Many different types of special furnaces have been evolved in the effort to improve the quality of iron or to cheapen its melting.

In the air-furnace group, attempts have been made to put a high chamber at the back end of the furnace, where a large amount of scrap was piled up, so that it could melt down as the heat progressed. In this connection, a type of furnace known as the Pittsburgh furnace was developed; and usually in charging a furnace of this kind, small but heavy scrap was piled in toward the fire box, and then the high part, or "kitchen," as it is called, was piled full of heavy scrap, pig, and miscellaneous material. Melting always began near the bridge wall and progressed back toward the stack, so that the material in the high part of the furnace was the last to be melted down by the heavy flame. In like manner, air furnaces have been arranged to operate with oil, powdered coal, or other fuel, and provided with a stack or cupola at the back in which the real melting took place, the hearth being in use for superheating or for any refining.

In connection with the cupola, as has already been mentioned, a forehearth or receiving ladle is of advantage; in recent years, this device has been used to reduce the sulphur, by adding an alkali to the forehearth. This method is particularly useful where the cupola is used for melting metal for duplexing to electric furnace.

Electric Furnaces.

So far as iron melting is concerned, electric furnaces divide themselves into two classes, known as direct-arc and indirect-arc furnaces. In the direct arc two or more electrodes are usually arranged in a vertical position, and an arc is struck between them and the charge, the current passing through the charge. In the indirect arc, the electrodes are in a more or less horizontal position, and the arc is struck directly between the electrodes without any contact with the charge. The indirect-arc type of furnace lends itself particularly to a rocking operation, in connection with which the part of the lining heated by radiation from the arc is rocked under the molten bath, serving to superheat the bath.

The first operations in America in making grey iron in the electric furnace used the direct-arc type furnace and experimented with the melting down of an all-scrap charge. Some of the first experiments used a basic-lined furnace and a second slag for reducing sulphur. In later operations, an acid lining has been used and no attempt made to reduce sulphur in the electric furnace. Where scrap with the possible addition of pig-iron is melted from cold metal in the electric furnace, there will be no pick-up of sulphur, and it is quite easy to control the amount of sulphur in the final castings. Where duplexing involving the melting of the iron in the cupola and the heating of it in the electric furnace is employed, sulphur may be reduced in the forehearth of the cupola by treatment with a suitable alkali. With the direct-arc-type of furnace the question of whether this process will pay depends upon several factors. On the Pacific Coast, the relatively high price of coke, the low price of electric current, and the low price of scrap make an electric furnace production of grey iron a very attractive proposition. In the East, at any point where electric current is particularly cheap it may be an attractive proposition.

Synthetic Cast Iron.

One exceedingly interesting case is that of the Century Electric Company, St. Louis. This company has a large percentage of very low-carbon steel scrap from the laminations of its motors, and with this material as a base, it has been making a synthetic grey iron. The process consists of having a baling press into which a certain amount of sheet metal was placed; then they put in a bag containing some cast-iron borings, some carbon in the form of scrap from the carbon works, and the necessary alloys of ferro-silicon and ferro-manganese. They then introduce some more steel and press the entire mass into a bale or block, which is charged into the electric furnace. With this is also charged the return scrap and sprues from the foundry and a small amount of coarse steel punchings. The entire mass is melted down into a high grade of grey iron. It is found that this metal is of essentially identical chemical composition with the cupola metal used formerly, and is 20 to 25 per cent. stronger. This additional strength gives a decided reduction in the breakage of delicate castings during machining operations and during shipment.

In the case of the Century Electric Company, the use of the scrap in the same building in which it originated saves transportation charges, and the foundry is arranged on such a schedule that the furnace keeps off from the line during the peak-load period. The result is a very nice melting arrangement, an improved product of iron, and a reduced cost of castings of approximately £6 a ton.

The company then decided to build a foundry to take care of its entire output, but here it immediately encountered the following factors: The new foundry was to be a continuous pouring unit, with a conveyor system. If sufficient electric furnaces were put in to handle the entire output in a single moulding shift, the electric current charge would be unduly high; if the moulds were all made in one period, put on the floor, and the furnace and shake-out gang worked throughout the 24 hours, there would be a big investment for building and poorer moulding economy, which would more than offset electric furnace gain. In the old location, the single electric furnace in use formed but a small part of the total load of the factory. In the new location, the electric furnace would be a considerable portion, and it was therefore decided to use the cupola method for the bulk of the castings.

There are three methods in common use operating electric furnaces of the direct-arc type; two of these methods have been in use for some time, and the third has recently been put into commercial operation. In the first, there is the direct melting of batches of cold metal, either of approximately the composition required or the making of synthetic iron by the addition of carbon and alloys. The second process is the duplexing, in which metal is melted in the cupola and superheated and refined in the electric furnace with or without the addition of alloys. In the third process, a fairly large electric furnace is used, say, of seven or eight tons capacity. In the morning a full batch is melted; throughout the day, ladles of, say, 1,000 lb. each are taken from the furnace and a corresponding amount of cold material charged immediately; this material will be melted and incorporated in the bath by the time the next 1,000 lb. is poured out. This continuous process is now in use and giving excellent results.

Electric Furnace Shows Advantages.

Electric furnace iron has a few advantages over cupola metal. The superheating of the metal makes possible its better deoxidisation, the freeing of it from gases, and the better combining of the carbon with the metal in strength, even though the composition be the more per cubic inch than cupola cast iron. It has a finer grain, and will run 25 per cent. or more above cupola metal in strength, even though the composition be the same. Also, this hot metal casts with less loss and, particularly, with fewer blowholes. As a consequence, the loss of castings in the machine shop is greatly reduced, machining qualities of the metal are also more uniform, and in most cases metal of a given composition seems to machine easier, which is probably due to the finely divided state of the carbon.

Advantages of Indirect Arc Melting of Borings.

The indirect-arc furnace is usually of a rocking type, and is not so well suited for melting down heavy or chunky material as is the direct arc; but for melting cast-iron borings of fine material it has distinct advantages over the direct-arc type, and there are to-day quite a number of plants of this kind in operation. An interesting fact is that by taking the borings from a given grade of cupola iron and then melting them in an electric furnace, one will obtain a metal of far superior quality, both from a wearing standpoint, from strength, and from machinability. As already explained, this is probably due to the better form of the carbon, to the superheating and also to the refining action.

Where the rocking type furnace is used, the charge generally consists of the back sprues and scrap, together with borings. Even where borings are badly oxidised, they can be cleaned up and the oxide reduced to metal, giving a good high-grade product; but, of course, the reduction of oxide is made at the expense of carbon, and to maintain the same percentage of carbon in the mix, it is necessary to add carbon in some form. Generally, for carbon additions in any electric furnace, petroleum-coke, or similar relatively pure carbon is better than high-ash coke, and in many cases, old electrodes or scrap from the carbon works may be used for this purpose.

Utilisation of Borings.

One of the prominent motor companies has run extensive experiments during the past year with this type of electric furnace, and is now planning to put in an extensive plant for utilising its borings. Where borings originate in a given plant, there is a distinct saving in converting them on the same property and turning them out as high-grade electric furnace castings; and under suitable conditions, this can be done in competition with cupola practice. This is due largely to the saving effected in handling, and the improvement in the quality of the product, in addition to the low market value of the borings. If an electric furnace unit is to be worked to a maximum output, advantage must be taken of at least a 20-hr. load, simply keeping off from the power lines during the peak period in the evening. This necessitates either moulding 20-hr. or storing the moulds. It is evident that, in the next few years, this process of reducing borings will be used very extensively by some of the large motor-car manufacturers. The Enot Foundry, at Wayne, Mich., recently installed several small Detroit electric furnaces, and turned out a line of high-grade castings on purchased borings. From a metallurgical standpoint, the operations were thoroughly successful; but from a handling standpoint, they decided that 800-lb. furnaces would be much better than the 300-lb. furnaces installed, and this new installation is now being put in.

High-Grade Castings Made from Purchased Borings.

It is perfectly feasible to work with commercial borings purchased in the open market, and to work into them a considerable portion of steel borings and turnings; but the metal composition must be watched carefully, and necessary corrections must be made by means of alloys or other metal additions. A number of firms have adopted a physical test to check the chemical test. In this connection, a step bar, having various thicknesses, ranging from $\frac{1}{8}$-in. or less up to approximately $\frac{3}{4}$-in., can be cast in an ordinary sand mould, cooled, and broken, and the operator will be able to judge his silicon and carbon balance very closely; this will enable him to make corrections to the bath without waiting for an analysis.

One concern has recently purchased and is now installing one battery of transformers with two electric furnaces. The transformers are so arranged that one of them can be used singly or they can be used in parallel. When used singly, they operate a 350-lb. brass melting furnace; when used together, they operate a 1,000-lb. iron-melting furnace. Both these furnaces can, of course, take a considerable overload in capacity. The iron-melting furnace will be used for supplying a small continuous moulding unit, and the brass-melting furnace will be used for taking off one or two brass heats at noon, for pouring the work moulded in the morning, and for taking off one or two heats late in the afternoon for pouring the rest of the work. Such combined units as this will be of great advantage to concerns having a certain amount of high-grade iron that must show special physical properties.

Mr. Cosmo Johns, who for many years was steel works manager to Messrs. Vickers, Limited, River Don Works, Sheffield, has recently retired from that position. Mr. Johns was a prominent member of the Iron and Steel Institute.

* See Foundry Trades Journal, Vol. 40, pp. 65 and 91.

Some Notes on Patternmaking.

By J. Delaney and R. Ballantine.

Of primary importance in patternmaking is the question of shop and equipment. In most works where a large patternshop is not required it has been the practice to place it in unsuitable places and in rather a makeshift manner, with the result that production suffers very often through defective lighting and the comfort of the workers being overlooked.

If possible, a patternshop should be on the ground floor, so that vibration caused by machines running at a high speed may be eliminated as much as possible. Plenty of natural light and a comfortable atmosphere are essential, the latter being associated with a ventilating and dust-collecting system installed, which will minimise the resultant dangers to health from wood dust. This is especially so in the case of firms who have a stucco-working department. The general layout may be best left for the particular class of work undertaken, but preferably there should be a wood floor.

Desirable Equipment.

The equipment of the workshop should be at least modern, and should not be the dumping department for obsolete machinery, such as lathes, planers and saw benches, as is very often the case. A good circular saw with adjustable fence is essential for ripping 11-in. × 3-in. yellow pine deals to the various thicknesses; a 20-in. combined planer and thicknesser is necessary—particularly for large work; whilst a 30-in. band saw is indispensable; moreover, it is maintained that it is the most useful machine in patternmaking, especially so if it has the tilting table for bevel work.

There should be a plentiful supply of lathes of varying sizes suitable for face plate and barrel work at different speeds. The sand-papering machine is most serviceable, and the double-disc type are best, with a disc diameter of 30 in. to 36 in., and a bobbin attachment for radial work. A liberal supply of end trimmers, a grindstone, a grinding cone for gauges, glue pots, a drilling machine, and a jig saw, and, finally, a surface table meets the needs of a modern and moderate-sized shop of, say, 20 men.

For the larger shops, a patternmaking machine is required, and is, with intelligent usage, a prolific worker of great value. Benches, vices, trestles, drawing boards, types and straight edges, should be to general standards.

The Patternmaker.

The ideal patternmaker should possess (apart from his ability to handle tools) the abilities of the draughtsman on one hand, and of the moulder on the other. He should be able to read any drawing readily, and visually form the object illustrated by the draughtsman, understand its details minutely, and decide in what way the pattern is to be moulded before he can confidently begin the construction of it, and so avoid the many pitfalls which occur through faulty anticipation.

Patternmaking is extremely varied and the worker has never finished adding to his knowledge in the many new designs which are continually appearing. Constant study is necessary on the patternmaker's part to keep pace with the new conditions. To be an expert patternmaker requires talents superior to those required for any branches of the engineering business, with the exception of designing. The trade is largely a woodworking one, but in a class by itself, in so far as the patternmaker is trained to the greatest accuracy in the woodworking art. In many cases the patternmaking department is looked upon as a stumbling block to the engineering world. The fact that patterns do not show in the finished product, and the expense incurred in producing them seems to be the only answer confirming this view. Consequently the employers look upon the patternshop as a necessary evil and a difficulty to be surmounted with the least possible trouble and expense, with the result that all sorts of makeshifts are resorted to for the purpose of eliminating patternmaking.

Economics of Patternmaking.

The moulder naturally thinks he is trying to teach him his business; but such is not the case. To maintain efficiency and the maximum production of castings co-operation is essential between drawing office, patternshop and foundry. This is easily overcome by the policy adopted in some establishments, of having a planning department, which is directly in touch with these departments, with the result that when a blue print is issued for a particular casting a patternmaker's print accompanies it with system of construction, coring, partings, etc., marked distinctly. For repetition work this method has much to commend it, and results are found to be most satisfactory.

In their own experience the authors find that patterns they make for certain customers are never questioned; but similar types of patterns made in exactly the same way for other customers would not be accepted by them, constituting a point in favour of a planning department. In the making of standard patterns, the quality of materials used and the workmanship cannot be of too high a class, and especially so in motor-car and aeroplane-engine work, where mahogany and teak wood are exclusively used, with aluminium or brass parts in the more delicate places. For ordinary general work of larger proportions yellow pine is ideal, provided it is dry. It is used in 90 per cent. of all work produced.

Procedure.

When drawings are received in the patternshop the foreman generally studies, (1) the type of pattern; (2) the number of castings required; and, lastly, to whom he shall allocate the particular job. The last is of vital importance, in as much as he would never dream of putting a squad worker who carries on under a leading hand on large marine work to make an intricate-cored and most accurate pattern, relying solely on his own efforts. The result would be disastrous in many ways. His estimate would be wrong, the quality and accuracy must needs suffer, and the foreman's mind would never settle until he had passed the job. He may, again, have a most intelligent patternmaker on whom he can rely but who never varies his standard of his craft instincts. This is a mistake, yet it is generally found in good workmen. It is maintained that the most competent patternmaker is the adaptable man who can produce a pattern for a one-off job, to meet the needs of a one-off job, and afterwards proceed with a first class job in the same adaptable way.

Drawings.

A common procedure is the issuing of preliminary prints, so that the patternmaker can proceed with the work, and so speed on deliveries. In many cases where delivery is urgent this system prevails. This method is defective for this reason: When the final print comes to hand the patternmaker finds that in many cases he has only just started, for the so-called small alterations of the drawing office in the finished drawing as compared with the preliminary print turn out to be both serious and annoying. Such alterations add considerably to the cost of the pattern, and very often more time is lost in altering than should be, and in the end is neither satisfactory to himself nor to the moulder who has to work with it.

When it is necessary, through competition, to have patterns good and cheap, the patternmaker must needs have a clear print. All plans, elevations and sections must be shown, so that a worker can read them readily and proceed with the job. All machined parts should be distinctly marked, and, if at all possible, the amount of machining to be left on. In many drawings the question also arises as to whether bolt-holes should be cored or bored; if these points were distinctly noted prior to the print leaving the drawing office it would enable the patternmaker to execute the work without questioning, and eventually save time in study and construction.

Cheap Patterns.

It is felt that the use of stucco for patternmaking in the engineering foundries is not given the place to which, by virtue of its qualities, it is entitled. There is unlimited scope for its use, particularly in jobs of one- or two-off, and in the construction of master patterns. In their own experience the authors have made patterns in wood which could easily, and much more economically, have been made in stucco. For example, they have made skeleton patterns of various sizes, bends and tee-pieces, and which, on being sent to particular foundries, were discarded as patterns, and only used as templates for the running up of stucco patterns. It can be run up to very fine limits, and regular thicknesses and sections, and to a thinness one could never hope to attain in wood.

Cost and Classification of Patterns.

Patternmaking, as in all other kinds of model work, can be made more or less expensive, according to the work required from the pattern. Again, the expense attendant on the use of the pattern is often unnecessarily increased owing to the abuse they receive in the foundry. Some moulders do not take the slightest care with patterns, and will abuse them more in the making of half a dozen castings than others will in making a hundred.

Patterns should be divided into three classes, and the cost of producing varied accordingly:—

(1) The pattern from which only one casting is required should be constructed with as little expense as possible, skeleton and framed work, and strickles wherever possible, no small filleting, and only web radius in large work, and all unpainted. In fact, any means may be adopted in the making of this pattern that will allow the moulder to make the casting, always remembering, of course, to give the foundry the minimum of work. After usage, these patterns should be destroyed, as they only take up valuable space.

(2) Patterns used occasionally, and sometimes at long intervals, should be constructed in a much more substantial manner, and should be carefully stored for future use; and

(3) Patterns which are frequently used. Too much care cannot be taken in the making of these, and, when properly constructed, are necessarily expensive in first cost. In the case of the smaller patterns, all fillets should be cut out of the solid, and in the larger type, leather fillets fixed, not with glue, but burned varnish. The authors adopted some time ago the use of plastic wood for filleting, and find it exceedingly good, and mostly so for irregular work and in making up of work which has suffered by undercutting or injury. The mahogany plastic wood grit is the one favoured by the authors, and when properly used is a boon to the patternmaker. A slight contraction takes place if put on too thickly, and it is advisable to work sparingly. When properly hardened it contains all the qualities of good wood, with the decided advantage of having no cross grain.

Typical Examples.

In propeller work, particularly in the largest type, the usual method is adopted of sweeping up in the foundry, the patternmaker supplying the necessary sweeps, barrel gable and section pieces for blade formation, which method cannot be improved. But in the case of propeller patterns of three or four blades, with tip diameters up to 4 ft., personal experience has led to the conclusion that easily the most satisfactory method of producing is the supplying of a segmental corebox, ¼ in. in the three-bladed type and ½ in. in the four-bladed, with one blade set in with boss section to suit. Many have been made in this way, and they have been most satisfactory to the founders. The moulder's work is very much lessened, being principally a coremaker's job. In some cases the patternmakers supply a sweep for scraping a bed, but this can be dispensed with.

Another example of labour saving, taken at random, is the case of radial tunnel-sections; where

* A Paper read before the Scottish Branch of the Institute of British Foundrymen, Mr. E. Longden presiding.

patterns are standard, and tremendous quantities of castings are required, the coring of bolt-holes is important, and in case of a tunnel-section of 6 ft. with a radius of about 8 ft. or 9 ft., illustrates this point.

The extreme holes in side-flanges require tail-prints with a much larger taper than is necessary for the centre holes. The authors' method in instances of this kind is to make a standard tail-print with sufficient taper to draw sweetly at extreme holes, and made large enough to include facings on the inside of the flange. By doing this, one corebox only is needed. In the matter of the end flanges, these must be loose, and generally two for each end are supplied, so that when the moulder is finishing the mould another box is being rammed. The flanges are interchangeable.

Bottle Moulds.

Another interesting class of work to the patternmaker, and one which should be of interest to foundrymen, is one which is perhaps out of the ordinary run. That is the amount of patternmaking and moulding required in the making of castings for manufacturing bottles.

A model is first made to the capacity and design required. This must be very accurately done and finely finished. After approval by the bottle-maker, the bottle is then used for the making of a chill, which is again used in making the bottle-mould castings. The bottle-mould pattern is then made in two halves, with a hinge arrangement for opening and closing. It depends greatly on the type of bottle whether these mould patterns are made in wood or stucco. As in the case of ordinary moulding in sand, the simplest method of parting applies for withdrawing the bottle. This will easily be observed on looking at any bottle (and the parting is shown), as is seen in many castings

A point worthy of note, and which tends for economy, is the supplying of half core-boxes only, when both halves are similar. In many shops full core-boxes are made at great expense, when no extra labour would be involved by the use of one half only in the foundry, and, moreover, the core can be handled much more easily by having a flat surface for turning out of the box, and which is appreciated by coremakers.

Contraction Allowances.

The problem of contraction allowance continually crops up in the various patterns, and to adhere hard and fast to the contraction rule is not to be advised. This necessitates the varying of the contraction allowance according to the type of work, involving close co-operation with the foundry. Some time ago the authors constructed a pattern for a centrifugal pump with double volute, and of a total depth over flanges of 3 ft. 6 in. The pattern was made to contraction rule, but contraction was dispensed with in the depth of the cores, and only allowed for in diameters and volutes. The casting on being tested was found to be accurate to sizes.

In making a large sluice-valve for experimental purposes, the bore being about 6 ft., with an internal part to finish accurately to that diameter, when cast, the diameter had become an oval, and, on being measured, showed a difference of about 1¼ in. This vital part was altered and the pattern was made oval to counteract the difference. The second on being cast came as originally intended. On investigation, faulty design was accounted to be the cause of this happening.

Taper in Patterns.

Regarding taper in patterns, in standard work it is necessary, and, as in contraction, no hard and fast rule need be worked to, and should be regulated by the type of pattern under construction. It is also necessary that it should be put where the moulder has no chance of seeing the sand while withdrawing the pattern. The average engineering patternmaker does not give this matter the attention which it deserves, and in most cases ignores it altogether, with the result that the moulder in using such a pattern is compelled to rap with force, and is either successful in destroying the mould or pattern. All flanges in patterns which are parted through the diameter should be tapered on inside, and at the same time slightly thickened when the face is machined to allow for any variance in contraction.

Gear Wheels.

In the matter of gearing, wheels with cast teeth of moderate dimensions present to the patternmaker difficulties and endless worry in the making of the teeth. No matter how careful or efficient the workman, the human element is always present, and slight variances in cutting of teeth are bound to occur whether made in a box or cut on a wheel. The best results are obtained from a wood gear cutting machine.

The cutting of existing patterns in the sand is a common practice, and certainly much can be done in this way by the moulder, and considerable expense saved thereby. A comparatively small amount of labour will often save the cost of a new pattern, by simply marking on the pattern the parts to be cut off, and supplying the necessary cutting pieces. As an example is the case of pavement-light patterns. These are generally standard in designs, and the many shapes and sizes necessary, caused by the various construction of modern buildings, demand continual alterations. In fact, we know of one firm in particular in which two patternmakers are constantly employed making cutting pieces for this particular work.

In the general run of engineering work there are limits even to this cutting in sand, and in some cases it is found the extra work thrown on to the foundry is overlooked in the desire to save in patternmaking. The authors have been asked on several occasions to alter patterns to such an extent that the ultimate cost in patternmaking and moulding would have far exceeded the cost of a new pattern. There are two sides to the question, and the work entailed in both foundry and patternshop must be taken into consideration when making a decision as to whether the cutting of a pattern is going to be economical or otherwise.

In hawse-pipe patterns for merchant vessels the practice of cutting pipes in the mould is very often done, and is necessary where the patterns are repeatedly used. In making such a pattern it is usual to build on the shell principle of making its own core. It is usually made five or six feet longer than is required. When built it is taken to the ship, or the "mock up" which is sometimes erected by the loftsman in wood, to represent the stem of the ship, and when located in position the model anchor is tried and the pattern adjusted and altered to ensure the run and housing of the chain and anchor. The forming of a shell flange which is cast on the hawse pipe finishes the ship's side-work. The deck flange is usually a separate casting; but before withdrawing the pattern from the ship, a line is scribed to the deck-level. On being taken to the patternshop the necessary contraction is added, and a new cutting line made. As this forms a very acute angle, and a difficult one for the moulder to cut cleanly, the authors are very much in favour of the system adopted in certain foundries of running a section of stucco up to the diameter inside and outside, and bevelling this accordingly. An accurate cut is assured, the moulder avoids the "footering" with his mould. The pattern remains intact for different lengths of future hawse pipes, and the stucco cutting-pieces can be used again by altering to the different angles.

The making of loam patterns in large cylindrical work is adopted in many cases, and certainly pays, in the use of large quantities of timber being saved. The main body is run up, with necessary recesses for locating flanges, bosses and other shapes, according to the particular job, these parts only being in wood. Should about six castings be required, the loam pattern can stand the usage in the making of that quantity with ordinary care. The main core is, in this case, made separately, all the internal parts being set by length sticks and scribed lines, when the core is rotating on the trestles. Good solid boards should be supplied, about 1¼ in. thick, to obviate sagging in the centre, and an allowance for trestle-room of 6 in. on each end.

Where loam boards are in constant use they should be lined with metal on the working face, size sticks for respective diameters being screwed on the bevelled side.

In built-up patternwork of circular design the segments are glued in a brick-band formation, which gives strength and at the same time retains the finished shape. Formerly a large amount of this pattern work was turned, but despite care and keen-cutting tools a certain amount of irregularity occurs, due to the side wood in one layer meeting the end wood of another layer. The best results are obtained by the use of the sandpapering machine using No. 1½ garnet paper. This ensures a pattern free from irregularities, and one which will leave a mould unbroken. In staved barrel work, drawn from the mould on end, it is advisable to carry the cleading right through the full length of the pattern to ensure a clean draw, which cannot be obtained if the pattern is so built that end-wood shows as in the built-up work previously mentioned. A "Corliss cylinder" pattern was constructed recently, suitable for two different sizes, the dimensions being, roughly, 6 ft. 6 in. in length, and the respective barrel sizes being 3 ft. and 3 ft. 2 in. outside. In the making of the pattern, the barrel was built to the smaller size for moulding on end, fixed flanges, boxed port parts, strengthening ribs, bosses, feet, etc., and finished in detail. Loose cleading was then made to make up to the larger size, and was fitted round the pattern; only the stiffening web in the centre of the pattern, which was fixed round barrel, was dismantled. All other dimensions remained similar in both cases. A loam board was supplied for each size of the main core. In the case of the port core boxes, these were made to suit the small bore and a scraping stick supplied to scrape out the difference to allow clipping to the larger core. This emphasises the saving accomplished in the making of one pattern for two distinct sizes of castings.

The finish of patterns is very important, and especially so in standard work. All mahogany and teak wood patterns should be shellac varnished, with a distinctive colouring for prints. In the case of larger work, in which yellow pine is used, a varnish paint is recommended, and can be chosen at the foreman's discretion from the many good qualities on the market. Larger patterns still should be given a protective coating of a good quick-drying oil paint. There is no doubt that varnish and paint tend to fill pores in wood, with the result a much finer finish is given to the castings. Malleable iron dowel-plates are most reliable, and are preferred to any other type. Draw straps and rapping plates should be placed in larger work where most suitable.

An American Hardening Furnace.—An electrical hardening furnace, which indicates the critical point of steel magnetically, has been placed on the market by the Hevi Duty Electric Company, Milwaukee. The furnace is similar to other heat-treating furnaces in design and operation. It is equipped with electrical circuits to establish a magnetic field through the work and a meter to measure the strength of this field. The circuits are so arranged that no deflection of the needle occurs with the furnace empty, but when steel is placed on the hearth, the meter immediately indicates an increase in the strength of the field caused by the magnetic properties of the steel. This method of heat-treating is adapted to all straight carbon steels of more than 0.4 per cent. carbon, and alloy steels whose critical temperature is below the safe working limits of the furnace. These include most of the usual tool steels, with the exception of those of high-speed quality. As the magnetic function is independent of the furnace temperature, maximum production can be obtained. Another development of the same Company is a pot for cyanide and lead hardening furnaces, which is built with corrugations to provide about 30 per cent. more heat-releasing and receiving surface than a straight-side pot of equal holding capacity. The corrugations also establish sufficient pinch effect in the material to secure a stirring action. This insures uniform distribution of temperature and conducts the heat from the walls rapidly, producing efficient operation.—"Iron Trade Review."

STANTON
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Trade Talk.

H.M. submarine "Orpheus," the second of two submarines at present under construction by Messrs. William Beardmore & Company, Limited, Dalmuir, was launched privately last Tuesday.

The employees of the District Engineer's department of the London and North Eastern Railway Company, Cowlairs, Glasgow, have contributed £113 4s. 10d. to charities in Glasgow and West of Scotland.

The management of Messrs. William Beardmore & Company's steel works at Mossend have informed the Parish Council that whilst they have hopes of resuming work at an early date, no definite time could be given at present.

Messrs. Sir W. G. Armstrong, Whitworth & Company, Limited, have received an order from the India Store Department, London, for the construction of 46 superheated locomotive boilers and for locomotive parts for the East Indian Railway Company and the Great Indian Peninsular Railway Company.

The United Molasses Company, Limited, have taken over two 13,000 ton motor-tankers building in the yards of Sir James Lithgow, Port Glasgow, with whom they have placed orders for a further two tankers of the same design and size. The new tankers will be built to the United Molasses Company's usual specification, which includes Burmeister and Wein engines, built by John G. Kincaid & Company, Greenock.

The Caledon Shipbuilding & Engineering Company, Limited, Dundee, have received an important contract from the Nederland Steamship Company, Amsterdam, for the building of two passenger and cargo motor vessels for their Eastern trade. The vessels will be 460 ft. long, and will be fitted with Sulzer-Diesel engines, capable of maintaining a sea speed of 15 knots. The machinery will be made at Sulzer Bros. Works, Winterthur, but will be installed by the builders at Dundee.

The liquidator of Messrs. Gillespie's, Limited, Bonnybridge, announces that he has accepted a tender for the sale of the Chattan Iron and Stove Works as a going concern. The tenderers are acting on behalf of a new company now in course of formation, who will carry on the business under the style of Mitchell, Russell & Company, Limited. The management of the works will be in the hands of Mr. James Mitchell, who has held responsible positions with Messrs. Smith & Wellstood, Limited, Bonnybridge, and Mr. G. Dearie Russell, O.B.E., a director of Messrs. Wood, Russell & Company, Limited, manufacturers of the "Sentinel Stove."

Obituary.

Mr. Alexander MacDonald, who was for 44 years in the employment of the Callendar Iron Company, Limited, Falkirk, died on February 8.

Mr. John Innes, head of a well-known firm of shipbuilders, died in Glasgow on February 18, at the age of 78 years. He retired from the firm of Patrick Henderson & Company about a year ago.

Mr. T. C. F. Harris, director of Messrs. Harris Bros. (Brierley Hill), Limited, iron merchants, has died at the age of 36 years. He was also a director of the Wellingborough Iron Company, Limited.

The death has occurred, at the age of 80 years, of Mr. George Clough, of 6, Prince's Crescent, Morecambe, who before retirement was for many years foundry manager for Messrs. Butterworth & Dickinson, Limited, of Burnley.

Colonel Bernard A. Firth, one of the best-known men in the Sheffield steel trade, died last week at his residence, Coates Manor, Cirencester, at the age of 63, after an illness of only three days. He was chairman of Messrs. Thomas Firth & Sons, Limited, and of the Projectile and Engineering Company, Limited, and a director of Messrs. John Brown & Company, Limited. Colonel Firth had a distinguished career in business and public life. He was born at Oakbrook, Sheffield, in 1866, and was the third son of the late Mr. Mark Firth, one of the founders of Messrs. Thos. Firth & Sons, Limited. He entered the business at the age of 17, and became successively a director, a managing director, and chairman of the company, a position in which he continued for many years. He also sat for many years on the directorate of the Great Northern Railway. He took a keen interest in municipal work, and for six years was a member of the Sheffield City Council. He was a member of the Cutlers' Company for a number of years, and had a term of service as Senior Warden. Colonel Firth had been an active member of the Volunteer and Territorial movements for a quarter of a century.

Nottingham Society of Engineers.

One of the most popular evenings organised by the Nottingham Society of Engineers during the winter season is the "short paper" meeting. Ever since its inception, this special occasion has proved a success, and at the 1929 event, held on Monday evening, February 11, there was a large gathering of members, over which the chairman presided. Ten minutes were allowed for the reading of each Paper, and perhaps one of the most interesting was that on "Training of Engineers" given by Mr. J. M. Dickson. He said the engineering profession was one of the few real professions in which education was not properly organised. Accountants, solicitors and architects all had fairly well defined courses of training in which general lines of education were laid down, but it was not the case with the engineer. There was no need to stress the importance of good education in any profession, and it was a reflection on this country that so far as education for engineering was concerned, it was behind such countries as Germany and America.

In a Paper on "Bearings" Mr. A. Beeston pointed out that the successful working of most machines depended on the care taken in the design, the fittings of the bearings and their proper lubrication and maintenance.

Mr. A. O. Fawcett gave a Paper on "Round the World in Eight Months," and Mr. A. E. Wheatley submitted one on "Notes on Modern Transport," which proved quite interesting.

Personal.

Mr. S. M. Turnbull, of the Greenock Dockyard Company, Limited, has been elected President of the Greenock Chamber of Commerce.

Mr. John Macpherson, of Grangemouth, has received a presentation from the local staff of the Carron Company on his retirement after 45 years' service in the Company.

Mr. R. D. Harris, who was for many years departmental manager in the smelting department at the Penistone Works of Messrs. Cammell, Laird & Company, Limited, was the recipient of a presentation from the staff of the works on the occasion of his recent retirement.

Mr. John Bray, who served his apprenticeship with Messrs. Holman Bros., engineers, Camborne, has been appointed foreman of the foundry and pattern shop of the Northern New York Foundry and Machinery Company, of Glen Falls, U.S.A., upon it being taken over by the Allen Air Appliance Company.

Mr. T. Miller, who has been for some time in the foundry department at the Lincoln Works of Messrs. Babcock & Wilcox, Limited, has been appointed foundry manager of Messrs. Dawson & Downie, Limited, Elgin Works, Clydebank. Messrs. Dawson & Downie are enlarging and modernising their foundry so that the production will be sufficient to cope with the needs of their engineering department.

Mr. George A. V. Russell will shortly be relinquishing his appointment as manager of the engineering department of the Brightside Foundry and Engineering Company, Limited, to take up an appointment with Imperial Chemical Industries, Limited. Mr. Russell has specialised in steelworks practice, and has had a very varied experience. Obtaining his engineering training at the locomotive works of the Great Western Railway, he gained his practical experience in open-hearth steel making and rolling-mill practice with the Partington Steel and Iron Company, Limited. He then became in succession assistant manager of the heavy forge and armour plate department of Messrs. John Brown & Company, Limited, assistant works manager, and later works manager of Messrs. Davy Bros., Limited, and chief engineer to Messrs. Lamberton & Company, Limited, Coatbridge, relinquishing this last-named appointment to join the staff of the Brightside Company in his present position.

Wills.

Jolly, J. McD., joint managing director of the Skefko Ball Bearing Company, Limited, Luton	£12,083
Preston, E., of Kidderminster, iron and brass founder	£21,737
Pugsley, J., chairman of Messrs. Joseph Pugsley & Sons, Limited, metal and machinery merchants, Bristol	£101,971

Proposed Iron and Steel Inquiry.

Confederation's Reply to the Prime Minister.

Mr. Arthur Pugh, secretary of the Iron and Steel Trades' Confederation, has now replied to the letter from Mr. Stanley Baldwin in which the Prime Minister intimated that the Government could not accede to the request of the Confederation for an inquiry into the conditions of the iron and steel industry, with a view to the adoption of measures to remedy the present depression.

The Executive Council of the Confederation, in their reply to the Premier's communication, state that while they are gratified by Mr. Baldwin's intimation of full sympathy with many of the opinions they advanced, they cannot but express disappointment that he has not seen fit to adopt their carefully considered proposal for a full and impartial inquiry into the iron and steel industry on the lines submitted. In connection with Mr. Baldwin's intimation that it was the policy of the Government, if returned to power, to allow the iron and steel industry to make an application under the Safeguarding of Industries procedure, when it would have an opportunity of stating its case before an independent tribunal, the Confederation state that they feel that the form of inquiry contemplated not only involves unnecessary delay, but, by being dependent upon the circumstances attending a Parliamentary election, cannot fail to introduce that element of political controversy which their proposal seeks to avoid, and which, in the view of the Council, has been an unfortunate—because detrimental—feature of the consideration given to the industry up to the present.

So far as the inquiry of the Balfour Committee is concerned, it is continued, it is true that in its general industrial survey its report makes a useful contribution to the information required, but, presumably, as Mr. Baldwin's letter contemplates a later inquiry, the Balfour report is not regarded as likely to be sufficiently complete or its findings sufficiently conclusive to enable the Government to deal specifically with the iron and steel industry. In conclusion, the Confederation Executive Council state that they feel that the terms of the Premier's communication do not disclose a policy and procedure in relation to this great basic industry which will enable its conditions to be treated on the basis of its importance in the economic life of the country, with that necessary freedom from political prejudices which the Council are anxious to secure and with due regard to all the interests involved. The Council therefore venture to hope that, on reconsideration, the Prime Minister may yet find it possible to set up a Committee on the lines they have proposed.

Catalogues Received.

Speciality Alloys.—We have received from Haywood's N.C.A. Metals, Limited, 29, Spring Gardens, Whitehall, London, S.W.1, a copy of a recent publication carrying the caption, "A Service to Industry." At the outset, a description is given of a non-corrodible aluminium alloy, which the manufacturers claim does not corrode in sea water. Ingots made from this metal are being supplied to the various non-ferrous foundries for remelting and casting into moulds for their individual use. Throughout this 16-page booklet, there are a number of micrographs. We confess to a prejudice against the printing of micros. on yellow paper, as the effect is somewhat destroyed thereby. Again, we feel sure that the average founder either receives no information from such reproductions, whilst the more erudite are insistent in their demand for the magnification to be stated. Thus we suggest that any future reprints of this handsome little brochure should be printed on white paper, and that more details of micros. should be given. The balance of the book is devoted to illustrated technical descriptions of high-tensile bronze, gun-metal, brass, phosphor-bronze, and white bearing metals.

New Companies.

Parker Foundry (1929), Limited.—Capital £20,000. Directors: F. C. Atkin, 8, Kelham Green, Nottingham; and O. D. Walker.

Martin Industries, Limited, Maltmill Lane, Blackheath, Staffs.—Capital £1,500. Casters and machiners of stainless steel, etc. Directors: W. E. Martin and J. A. R. Berlyn.

Mitchell, Russell & Company, Bonnybridge.—Private company, capital £50,000 in £1 shares. Subscribers: James Mitchell, ironfounder, Glasgow; Alexander Mitchell, ironfounder, Bonnybridge.

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Iron and Steel Markets.

Pig-Iron.

MIDDLESBROUGH.—Conditions in the Cleveland iron market remain, to some extent, indefinite and somewhat erratic, and although, as generally admitted, consumptive demand indicates steady expansion, there is at present some difficulty on the part of makers in fulfilling current requirements for prompt deliveries. The bulk of the iron produced in the area is already ear-marked for consumption at the local steelworks, but a few sales to Scotland have been arranged, and if the cold weather abates, foreign shipments will also be speeded up, as there is a better export demand. With regard to price, makers affirm that, even with the recent advance, quotations do not cover cost, and it is possible that there may be another advance. The recent severe weather has somewhat retarded shipments, but more iron has been sold of late to the Continent, and, with improving conditions, the exports should increase. In the conditions thus outlined, buyers express a firm confidence that they are are not likely to get better terms, and orders are being placed for deliveries as far ahead as June next, on the basis of current prices, which, both for home and foreign deliveries, are as follow:—No. 1 Cleveland foundry iron, 69s. 6d. per ton; No. 3 G.M.B., 67s.; No. 4 foundry, 66s.; No. 4 forge iron, 65s. 6d. per ton.

The outstanding feature of the East Coast hematite trade at the moment is the scarcity of supplies. It is difficult to place a fresh order with any prospect of prompt delivery. Thus, new business is chiefly confined to March/April deliveries, and buyers are not hesitating to buy forward at current rates, but 72s. 6d. per ton for mixed numbers and 73s. for No. 1 quality are quite minimum figures. On the North-West Coast hematite pig is experiencing a strong home and overseas demand, with Bessemer mixed numbers still quoted at 72s. per ton at works.

LANCASHIRE.—Recent orders and contracts placed with foundries in the Lancashire area show that demand for pig-iron is fairly well maintained, but after the extensive buying of the past few weeks the business negotiated of late has taken a distinctly quieter turn. A satisfactory feature of the situation, however, is the fact that deliveries against contracts are on a fairly good scale, and makers are not handicapped by cumbersome additions to stocks of foundry iron at the blast furnaces. So far as general price conditions are concerned, the firmer tendency lately in evidence has been well maintained. For delivery Manchester or equal distance, quotations for Derbyshire iron are about 70s. 6d. per ton, Staffordshire brands 72s. 6d. to 75s. per ton, and Scottish brands from 88s. to 90s. per ton, also delivered.

THE MIDLANDS.—Consumers of foundry pig in the Black Country districts have hardly as yet settled down to the revised list of prices recently intimated by the leading Midland furnaces, and consequently buying for the time being is on a somewhat restricted scale. This position was more or less anticipated, but the ironfounders will have to come into the market soon on account of the meagre stocks held by most of them, as they have for some time limited buying to hand-to-mouth requirements. Quotations, so far, remain firm as follow:—Derbyshire No. 3, 62s. 6d.; Northants, 57s. 6d.; with North Staffordshire at 67s. 6d., but with little success in the way of securing business.

SCOTLAND.—Although little improvement may be noted in the demand for foundry pig on local account, consumers are more inclined to take an interest in the placing of orders for forward delivery, and some moderate business has been done on the basis of the current price of 71s. for No. 3 foundry f.o.t. furnaces. Consumers, no doubt, are induced to make these purchases by the realisation that, while prices cannot go lower, they are likely to go higher and, as a matter of fact, it is possible that some alteration may shortly be made in the basis price.

Finished Iron.

The slight improvement noted recently with regard to crown iron is maintained. Prices are inclined to be firmer, and an average price to-day would be £9 5s., up to £9 10s. delivered Black Country area. Although business is somewhat better, there remains plenty of competition, and the requirements are nothing near sufficient to keep the ironworks fully occupied. Orders for nut and bolt iron are very poor, and little support is forthcoming from consumers in this direction, as foreign competition remains very much in evidence. The Belgian product is quoted at £7 5s. to £7 7s. 6d., delivered Darlaston district, and the cheapest local iron would be £8 10s. to £8 15s. Staffordshire marked bars remain in comparatively good request at £12 at makers' works.

Scrap.

Following the long period of slackness in demand, stocks of foundry scrap material have become short, and there is some difficulty in the Tees-side district in filling orders promptly. The local foundries are still rather inactive, and while up to 62s. per ton has been realised for ordinary qualities, only 5s. premium can be obtained for good machinery quality in handy pieces. At Birmingham this week heavy machinery cast-iron scrap, in cupola sizes, was being offered at 67s. 6d. delivered, and light material at 55s. delivered. It is reported that sales are taking place at these figures. In Scotland the cast-iron scrap market has improved recently, and there is a somewhat better demand, particularly for machinery cast-iron at 68s. 6d. to 70s. per ton, with heavy ordinary cast-iron to the same specification, 63s. 6d. to 65s. Cast-iron railway chairs are quoted at 66s. 6d. to 67s. 6d., and light cast-iron scrap at 61s. 3d. to 62s. 6d.; all delivered at works.

Steel.

The outlook in the steel industry continues on an improving basis, and at Sheffield this week orders were more numerous, although not of great weight. Some good contracts for heavy manufactured steel are to hand. Shipyard demands are better, but the railways are very chary in placing business. The demand for special steels is rather better. There has been a fair amount of activity in the semi-finished steel market, some good inquiries having been in circulation. The bulk of this business has been taken by British producers, who are inclined to quote stiffer prices in some districts owing to the higher cost of raw material. The tone of the tinplate market continues quietly steady, with quotations ranging as follow:—Coke tinplates, 18s. to 18s. 3d. basis, net cash, f.o.b. Welsh ports.

Metals.

Copper.—With some reaction after the recent period of active demand, the market for warrant copper of late has taken a quieter turn, although values, it should be noted, are still maintained at fairly high levels. Consumers are at the moment probably well covered for all their requirements for some weeks to come, but interest in the future is very strong, and it would appear that the absence of buyers in the market at present is only temporary and that a revival of activity may be looked for in the near future.

Closing quotations are:—

Cash.—Thursday, £77 1s. 3d. to £77 2s. 6d.; Friday, £77 16s. 3d. to £77 18s. 9d.; Monday, £78 3s. 9d. to £78 5s.; Tuesday, £79 13s. 9d. to £79 16s. 3d.; Wednesday, £81 5s. to £81 6s. 3d.

Three Months.—Thursday, £77 16s. 3d. to £77 17s. 6d.; Friday, £78 11s. 3d. to £78 12s. 6d.; Monday, £78 17s. 6d. to £78 18s. 9d.; Tuesday, £80 7s. 6d. to £80 8s. 9d.; Wednesday, £82 3s. 9d. to £82 5s.

Tin.—Movements in the market for standard tin during the current week have disclosed few features of interest, but prices on the whole remain fairly steady in the absence of substantial dealings. With regard to the future, opinions continue to differ as widely as ever. One thing is certain, however—that is, the continued provision of considerable resistance against lower price levels, but the only possibility of an upward trend in values would appear to be in the event of the attraction of a buying interest from outside consumers.

Official closing prices:—

Cash.—Thursday, £221 15s. to £222; Friday, £220 10s. to £220 12s. 6d.; Monday, £221 12s. to £221 15s.; Tuesday, £220 10s. to £220 15s.; Wednesday, £220 12s. 6d. to £220 15s.

Three Months.—Thursday, £222 15s. to £223; Friday, £221 10s. to £221 12s. 6d.; Monday, £222 12s. 6d. to £222 15s.; Tuesday, £222 to £222 5s.; Wednesday, £222 12s. 6d. to £222 15s.

Spelter.—Notwithstanding rumours that the Cartel have decided to reduce production by 10 per cent. conditions in the spelter market have been dull, with only a very moderate demand from consumers generally. On account of the lack of inquiry prices at the moment show no tendency to advance.

Daily quotations are:—

Ordinary.—Thursday, £26 2s. 6d.; Friday, £26 5s.; Monday, £26 6s. 3d.; Tuesday, £26 6s. 3d.; Wednesday, £26 6s. 3d.

Lead.—The market for foreign pig of late has developed a firmer tone, and the demand both from Continental and domestic consumers has been good. Values have appreciated as a result of the smaller supplies available, and as there is every indication of a maintenance of the present demand, a decline in the future does not seem likely.

Prices have been:—

Soft Foreign Prompt.—Thursday, £23 8s. 9d.; Friday, £23 16s. 3d.; Monday, £23 10s.; Tuesday, £23 12s. 6d.; Wednesday, £23 13s. 9d.

Students' Corner

Q.—What is the percentage of water permissible in facing sands, and foundry sands generally?

A.—For green sand facings, 5 per cent.; for dry-sand facings, 7 to 8 per cent.

Q.—Why should the coal-dust be increased in the facing sand for thick castings?

A.—Because the section of metal being thicker it takes longer to solidify and cool down, hence the protecting carbon film deposited by the coal-dust needs to be increased.

Q.—What is meant by strong, medium, and weak sand?

A.—Simply expressed, this is based on clay, or bond content.

Q.—What is meant by tough milled sand, and why is it necessary for dry-sand work and heavy castings?

A.—The supposition that the bond of a moulding sand lies in the colloidal matter which constitutes a portion of what is known as clay. The bond value is increased mechanically by rubbing, treading, beating and milling. The colloidal matter is not actually increased, but is distributed by milling and mixing, therefore rubbing particle against particle, grain against grain, and so a higher bond-value is obtained.

The bond, if necessary, can be still further increased by the addition of clean common clay, preferably previously dried and ground to fine powder.

This treatment naturally toughens, and makes the sand very dense, therefore less porous, and the permeability is decreased.

It is after a casting has been poured that the bond or colloidal matter is destroyed, or burnt out, as the moulding sand is subjected to intense heat when in direct contact with the high temperature of the molten metal.

Q.—What are the essentials for the various sands for thin and thick sections?

A.—For iron castings, ¼ inch thick—fine weak sand; for iron castings, 1 inch thick—medium, fine sands; for iron castings, 2 inches (and upwards)—strong sand; for heavy dry-sand, and core work—milled sand with the addition of opening material and moisture loam mixtures; for barrel, strickle, and brickwork (roughing and finishing)—sand ground in roller mill to a stiff or sloppy condition (as required), with the addition of extra moisture for plasticity, plus opening material for porosity—and sometimes cow hair for cohesiveness.

A weak or strong sand, by being ground in a roller mill, can be entirely spoilt and made unfit for moulding purposes. The continual grinding makes the sand so close, dense, and clayey, that air will not pass through it. Its natural porosity is entirely destroyed.

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Wire bars	85 10 0
Do. March	85 10 0
Do. April	85 10 0
Ingot bars	85 10 0
H.C. Wire rods	89 15 0
Off. av. cash, January	75 11 11 19/32
Do. 3 mths., January	73 14 10 15/16
Do., Sttlmnt., January	75 12 1 13/16
Do., Electro, January	78 17 0 5/16
Do., B.S., January	77 12 6
Aver. spot price, copper, Jan.	75 11 11 19/32
Do. Wire bars, January	79 2 0 5/16
Solid drawn tubes	15d.
Brazed tubes	15d.
Wire	10½d.

BRASS.

Solid drawn tubes	12½d.
Brazed tubes	14½d.
Rods, drawn	11½d.
Rods, extd. or rlld.	7½d.
Sheets to 10 w.g.	11½d.
Wire	10½d.
Rolled metal	10½d
Yellow metal rods	7½d.
Do. 4 × 4 Squares	8d.
Do. 4 × 3 Sheets	8½d.

TIN.

	£ s. d.
Standard cash	220 12 6
Three months	222 12 6
English	221 0 0
Bars	223 0 0
Straits	225 10 0
Australian	223 0 0
Eastern	225 2 6
Banca	223 15 0
Off. av. cash, January	222 16 3
Do., 3 mths., January	222 14 1 17/32
Do., Sttlmt., January	222 15 10 10/11
Aver. spot, January	222 16 3

SPELTER.

	£ s. d.
Ordinary	26 6 3
Remelted	25 0 0
Hard	20 5 0
Electro 99.9	28 15 0
English	26 15 0
India	22 0 0
Zinc dust	(Nom.) 36 10 0
Zinc ashes	8 5 0
Off. aver., January	26 4 3 1/32
Aver., spot, January	26 3 11 1/32

LEAD.

	£ s. d.
Soft foreign ppt.	23 13 9
English	25 0 0
Off. average, January	22 4 6 6/13
Average spot, January	22 2 2 15/32

ZINC SHEETS, &c.

	£ s. d.
Zinc sheets, English	34 0 0
Do. V.M. ex whf.	33 5 0
Rods	44 0 0
Boiler plates	32 0 0
Battery plates	32 15 0

ANTIMONY.

	£ s. d.
Special brands, Eng.	54 10 0
Chinese	38 5 0
Crude	33 10 0

QUICKSILVER.

	£ s. d.
Quicksilver	22 3 9

FERRO-ALLOYS AND STEEL-MAKING METALS.

Ferro-silicon—	
25%	£7 17 6
45/50%	£12 0 0
75%	£19 10 0
Ferro-vanadium—	
35/50%	13/9 lb. Va.
Ferro-molybdenum—	
70/75% c. free	3/8 lb. Mo.
Ferro-titanium—	
23/25% carbonless	1/- lb.
Ferro-phosphorus, 20/25%	£18 0 0
Ferro-tungsten—	
80/85%, c. fr.	1/8 lb.
Tungsten metal powder—	
98/99%	1/11 lb.
Ferro-chrome—	
2/4% car.	£30 2 6
4/6% car.	£21 0 0
6/8% car.	£20 15 0
8/10% car.	£20 0 0
Ferro-chrome—	
Max. 2% car.	£32 10 0
Max. 1% car.	£34 0 0
Max. 0.70% car.	£40 0 0
70% carbonless	1/- lb.
Nickel—99%, cubes or pellets	£175 0 0
Ferro-cobalt	9/3 lb.
Aluminium 98/99%	£95 0 0
Metallic chromium—	
96/98%	2/6 lb.
Ferro-manganese (net)—	
76/80% loose	£13 15 0
76/80% packed	£14 15 0
76/80%, export	£14 10 0
Metallic manganese—	
94/96%, carbonless	1/6 lb.

Per ton unless otherwise stated.

HIGH-SPEED TOOL STEEL.

Finished bars, 14% tungsten	£0 2 0
Finished bars, 18% tungsten	£0 2 9

Per lb. net, d/d buyers' works.

Extras—

Rounds and squares, 3 in. and over	4d. lb.
Rounds and squares, under ½ in. to ¼ in.	3d. lb.
Do., under ¼ in. to 7/64 in.	1/- lb.
Flats, ½ in. × ¼ in. to under 1 in. × ½ in.	3d. lb.
Do., under ½ in. × ¼ in.	1/- lb.
Bevels of approved sizes and sections	6d. lb.

Bars cut to length, 10% extra.

SCRAP.

	£ s. d.
South Wales—	
Heavy steel	3 12 6
Bundled steel and shrngs.	3 5 6 to 3 10 0
Mixed iron and steel	3 5 0 to 3 6 0
Heavy cast iron	3 0 0 to 3 1 0
Good machinery for foundries	3 2 6
Cleveland—	
Heavy steel	3 2 6
Steel turnings	2 12 6
Cast iron borings	2 5 6
Heavy forge	3 10 0
W.I. piling scrap	3 5 6
Cast-iron scrap	3 2 0 to 3 5 0
Lancashire—	
Cast-iron scrap	2 15 0 to 3 7 6
Hvy. wrought	3 12 6
Steel turnings	2 8 6 to 2 10 0
Scotland—	
Heavy steel	3 10 0
Cast-iron borings	2 14 6
Wrought-iron piling	3 8 6
Heavy machinery	3 10 0

London—Merchants' buying prices delivered yard.

	£ s. d.
Copper (clean)	57 0 0
Brass	39 0 0
Lead (less usual draft)	19 0 0
Tea lead	16 0 0
Zinc	16 10 0
New aluminium cuttings	67 0 0
Brazierv copper	52 0 0
Gunmetal	55 0 0
Hollow pewter	150 0 0
Shaped black pewter	105 0 0

PIG-IRON.

(f.o.t. unless otherwise stated.)

N.E. Coast—	
Foundry No. 1	69/6
Foundry No. 3	67/-
Foundry No. 4	66/-
Forge No. 4	65/6
Hematite No. 1	73/-
Hematite M/Nos.	72/6
N.W. Coast—	
Hem. M/Nos. d/d Glas.	79/-
,, d/d Birm.	86/6
Midlands—	
Staffs. common*	75/-
,, No. 4 forge	60/-
,, No. 3 fdry.	67/6
Shrops. basic	—
,, Cold blast, ord.*	—
,, ,, roll iron*	—
* d/d Birmingham.	
Northants forge	52/6
,, fdry. No. 3	57/6
Derbyshire forge	59/-
,, fdry. No. 3	60/- to 62/6
,, basic	65/-
Scotland—	
Foundry No. 1	73/6
,, No. 3	71/-
Hem. M/Nos.	75/-
Sheffield (d/d district)—	
Derby forge	64/-
,, fdry. No. 3	66/-
Lincs. forge	63/6
,, fdry. No. 3	67/6
E.C. hematite	82/6
W.C. hematite	83/6
Lincs. (at furnaces)—	
Forge No. 4	59/-
Foundry No. 3	63/-
Basic	62/-
Lancashire (d/d eq. Man.)—	
Derby forge	—
,, fdry. No. 3	70/6
Northants foundry No. 3	—
Dalzell, No. 3(special)	100/- to 102/6
Summerlee, No. 3	88/- to 90/-
Glengarnock, No. 3	88/- to 90/-
Gartsherrie, No. 3	88/- to 90/-
Monkland, No. 3	88/- to 90/-
Shotts, No. 3	88/- to 90/-

FINISHED IRON AND STEEL.

Usual District deliveries for iron; delivered consumers' station for steel.

Iron—	£ s. d.	£ s. d.
Bars (cr.) nom.		10 5 0
Nut and bolt iron	8 10 0 to 8	17 6
Hoops		11 10 0
Marked bars (Staffs.) f.o.t.		12 0 0
Gas strip		11 10 0
Bolts and nuts, ½ in. × 4 in.		15 5 0
Steel—		
Ship plates	8 7 6 to 8	12 6
Boiler plts.		10 10 0
Chequer plts.		10 12 6
Angles		7 17 6
Tees		8 17 6
Joists		7 17 6
Rounds and squares, 3 in. to 5½ in.		8 17 6
Rounds under 3 in. to ½ in. (Untested)		7 15 0
		and upwards
Flats, over 5 in. wide and up		8 7 6
Flats, 5 in. to 1½ in.		7 17 6
Rails, heavy		8 10 0
Fishplates		12 10 0
Hoops (Staffs.)		10 10 0
Black sheets, 24g.	10 0 0 to 10	10 0
Galv.cor.shts..24g.	13 12 6 to 13	15 0
Galv. fencing wire 8g. plain		12 10 0
Billets, soft	6 5 0 to 7	0 0
Billets, hard	7 5 0 to 8	0 0
Sheet bars	6 0 0 to 6	2 6
Tin bars	8 0 0 to 6	2 6

PHOSPHOR BRONZE.

	Per lb. basis
Strip	1 3½
Sheet to 10 w.g.	1 4½
Wire	1 5½
Rods	1 4½
Tubes	1 9½
Castings	1 3

Delivery 3 cwt. free.
10% phos. cop. £40 above B.S.
15% phos. cop. £50 above B.S.
Phosphor tin (5%) £30 above price of English ingots.
C. Clifford & Son, Limited.

NICKEL SILVER, &c.

	per lb
Ingots for raising	10d. to 1/4
Rolled—	
To 9 in. wide	1/4 to 1/10
To 12 in. wide	1/4½ to 1/10½
To 15 in. wide	1/4½ to 1/10½
To 18 in. wide	1/5 to 1/11
To 21 in. wide	1/5½ to 1/11½
To 25 in. wide	1/6 to 2/-
Ingots for spoons and forks	10d. to 1/6½
Ingots rolled to spoon size	1/1 to 1/9½
Wire round—	
3/0 to 10 G.	1/7½ to 2/2½

with extras according to gauge.

AMERICAN IRON AND STEEL.

At Pittsburgh unless otherwise stated.

	Dols.
No. 2X foundry, Phila.	21.26
No. 2 foundry, Valley	18.00
No. 2 foundry, Birm.	16.50
Basic	19.26
Bessemer	20.79
Malleable	20.01
Grey forge	19.26
Ferro-mang. 80% d/d	105.00
O.-h. rails, h'y at mill	43.00
Bess billets	33.00
O.-h. billets	33.00
O.-h. sheet bars	34.00
Wire rods	42.00
	Cents.
Iron bars, Phila.	2.12
Steel bars	1.95
Tank plates	1.90
Beams, etc.	1.90
Skelp, grooved steel	1.90
Skelp, sheared steel	1.90
Steel hoops	2.20
Sheets, black, No. 24	2.85
Sheets, galv., No. 24	3.60
Sheets, blue an'l'd, 9 and 10	2.10
Wire nails	2.65
Plain wire	2.50
Barbed wire, galv.	3.30
Tinplates, 100 lb. box	$5.35

COKE (at ovens)

Welsh foundry	25/- to 30/-
,, furnace	21/- to 27/6
Durham and North.	
,, foundry	16/-
,, furnace	15/6
Midlands, foundry	—
,, ,, furnace	15/6

TINPLATES.

f.o.b. Bristol Channel ports.

I.C. Cokes	20×14 box	18/-
,,	28×20 ,,	36/-
,,	20×10 ,,	26/3
,,	18½×14 ,,	18/9
C.W.	20×14 ,,	15/-
,,	28×20 ,,	33/6
,,	20×10 ,,	21/3
,,	18½×14 ,,	15/-
Terneplates	28×20	33/6 per box basis f.o.b.

SWEDISH CHARCOAL IRON & STEEL.

Pig-iron	£6 0 0 to £7 10 0
Bars, hammered, basis	£17 10 0 to £18 10 0
Bars & nailrods, rolled, basis	£15 15 0 to £16 15 0
Blooms	£10 0 0 to £12 0 0
Keg steel	£32 0 0 to £33 0 0
Faggot steel	£20 0 0 to £24 0 0
Bars & rods, dead soft, steel	£10 0 0 to £14 0 0

All per English ton, f.o.b. Gothenburg

TUBES AND FITTINGS.

Up to and incl. 6 in.

	Tubes.	Fittings.
Gas	67½%	50%
Water	63½%	45%
Steam	60%	40%

W.I. 10% extra.

DAILY FLUCTUATIONS.

Standard Copper (cash).

	£	s.	d.		
Feb. 21	77	1	3	inc.	5/-
„ 22	77	16	3	„	15/-
„ 25	78	3	9	„	7/6
„ 26	79	13	9	„	30/-
„ 27	81	5	0	„	27/3

Electrolytic Copper.

	£	s.	d.		
Feb. 21	84	0	0	inc.	10/-
„ 22	84	0	0	No change	
„ 25	84	0	0	„ „	
„ 26	85	0	0	inc.	20/-
„ 27	86	10	0	„	30/-

Standard Tin (cash).

	£	s.	d.		
Feb. 21	221	0	0	inc.	5/-
„ 22	220	10	0	dec.	25/-
„ 25	221	12	6	inc.	22/6
„ 26	220	10	0	dec.	22/6
„ 27	220	12	6	inc.	2/6

Tin (English ingots).

	£	s.	d.		
Feb. 21	222	5	0	inc.	15/-
„ 22	221	0	0	dec.	25/-
„ 25	222	5	0	inc.	25/-
„ 26	221	0	0	dec.	25/-
„ 27	221	0	0	No change	

Zinc Sheets (English).

	£	s.	d.		
Feb. 21	34	0	0	No change	
„ 22	34	0	0	„ „	
„ 25	34	0	0	„ „	
„ 26	34	0	0	„ „	
„ 27	34	0	0	„ „	

Spelter (ordinary)

	£	s.	d.		
Feb. 21	26	2	6	No change	
„ 22	26	5	0	inc.	2/6
„ 25	26	6	3	„	1/3
„ 26	26	6	3	No change	
„ 27	26	6	3	„	„

Lead (English).

	£	s.	d.		
Feb. 21	24	15	0	No change	
„ 22	25	0	0	inc.	5/-
„ 25	24	15	0	dec.	5/-
„ 26	24	15	0	No change	
„ 27	25	0	0	inc.	5/-

AVERAGE MONTHLY PRICES OF RUBIO ORE (MIDDLESBROUGH).

Year	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Yearly Average
1895	£ s. d. 0 12 0	£ s. d. 0 12 0	£ s. d. 0 11 10	£ s. d. 0 12 0	£ s. d. 0 12 0	£ s. d. 0 12 3	£ s. d. 0 12 3	£ s. d. 0 12 4	£ s. d. 0 12 9	£ s. d. 0 12 6	£ s. d. 0 12 7	£ s. d. 0 12 6	£ s. d. 0 12 2½
1896	0 12 6	0 12 6	0 12 9	0 12 9	0 12 9	0 12 7	0 12 9	0 12 9	0 12 9	0 13 6	0 15 0	0 14 9	0 13 1
1897	0 15 3	0 15 6	0 15 3	0 15 0	0 14 0	0 14 3	0 14 3	0 14 0	0 14 0	0 15 0	0 14 3	0 15 3	0 14 8
1898	0 15 0	0 14 4	0 14 9	0 14 6	0 15 0	0 15 0	0 14 0	0 14 0	0 14 0	0 14 9	0 15 0	0 14 9	0 14 7
1899	0 15 0	0 15 3	0 15 6	0 15 6	0 15 9	0 16 0	0 17 6	0 18 0	0 17 9	0 18 0	0 19 0	1 0 0	0 16 11½
1900	1 1 0	1 0 6	1 1 0	1 0 9	1 1 0	1 1 0	1 1 3	1 1 6	1 1 3	1 1 3	1 0 0	0 18 0	1 0 8½
1901	0 17 6	0 16 0	0 15 0	0 14 6	0 15 6	0 15 9	0 14 9	0 15 3	0 15 9	0 15 9	0 15 9	0 15 9	0 15 7½
1902	0 15 6	0 15 0	0 16 0	0 16 0	0 15 6	0 15 3	0 15 6	0 16 0	0 16 0	0 16 0	0 15 9	0 15 6	0 15 8½
1903	0 15 6	0 16 0	0 16 6	0 16 3	0 16 3	0 16 10	0 15 9	0 15 6	0 15 6	0 14 9	0 14 9	0 15 1	0 15 8
1904	0 14 9	0 15 3	0 15 1	0 15 4	0 15 3	0 15 0	0 14 5	0 14 6	0 14 6	0 14 6	0 14 6	0 14 7	0 14 9½
1905	0 15 3	0 15 6	0 15 0	0 15 3	0 15 6	0 15 6	0 15 6	0 15 6	0 16 6	0 18 6	0 18 9	0 18 9	0 16 3½
1906	1 0 0	1 1 6	1 0 0	1 0 0	0 19 6	1 0 0	0 19 6	0 19 4	1 0 6	1 1 6	1 1 9	1 3 6	1 0 7
1907	1 3 6	1 2 6	1 2 6	1 2 0	1 1 6	1 2 3	1 2 3	1 2 0	1 1 0	0 19 0	0 18 9	0 17 6	1 1 2½
1908	0 16 6	0 15 0	0 15 0	0 15 6	0 15 3	0 15 0	0 15 0	0 14 9	0 15 0	0 16 0	0 16 0	0 16 0	0 15 5½
1909	0 15 9	0 16 3	0 16 0	0 16 0	0 16 3	0 16 6	0 16 0	0 16 0	0 17 0	0 17 0	0 17 6	0 17 6	0 16 6
1910	1 0 4	1 0 9	1 0 9	1 0 9	1 0 9	1 0 9	1 0 9	1 0 3	1 0 3	1 0 6½	1 1 3	1 1 5	1 0 9½
1911	1 2 2½	1 2 6	1 2 6	1 1 11½	1 0 11½	0 19 6	0 19 0	0 19 0	0 19 1½	0 19 6	1 0 0½	1 1 6½	1 0 7½
1912	1 2 3	1 2 6	1 2 6	1 1 1½	1 1 6	1 1 6	1 1 6	1 2 3	1 2 6	1 3 0	1 3 0	1 2 11	1 2 2½
1913	1 2 9	1 2 2	1 1 7½	1 1 6	1 0 8½	1 0 0	1 0 0	1 0 0	0 19 10½	0 19 1½	0 19 0	0 19 0	1 0 5½
1914	0 18 7½	0 18 0	0 18 0	0 17 9	0 17 6	0 17 6	0 17 1½	0 19 7½	0 18 11½	0 17 10½	0 18 7½	1 1 0½	0 18 5½
1915	1 7 7½	1 8 6	1 9 3	1 10 2½	1 8 6	1 6 4	1 5 10½	1 6 0	1 6 10½	1 10 8½	1 13 0	1 17 10	1 9 1½
1916	1 18 6	2 0 1½	2 2 6½	2 0 6½	1 15 0	1 16 3	1 18 0	1 18 0	1 18 0	—	—	—	—
1917	} Price fixed												
1918													
1919	—	—	—	—	2 5 7½	2 14 4½	2 16 4½	2 14 0	2 13 4½	2 13 0	2 12 7½	2 11 9	—
1920	2 17 0	3 7 9	2 15 6	3 6 7	3 0 0	2 15 0	2 14 0	2 9 9	2 7 6	2 11 0	2 12 3	2 10 0	2 15 0
1921	2 1 0	2 0 1½	1 18 3	1 17 6	1 17 6	1 17 6	1 17 6	1 5 0	1 8 9½	1 7 9	1 7 0	1 7 0	1 13 8½
1922	1 6 7½	1 5 10½	1 6 11	1 7 0	1 7 0	1 7 0	1 5 3	1 4 9½	1 4 2½	1 3 3½	1 2 6	1 2 3	1 5 2½
1923	1 2 9½	1 4 6½	1 5 2	1 4 8½	1 4 6	1 4 0	1 3 6	1 3 0	1 3 0	1 3 0	1 3 2½	1 4 9	1 3 10½
1924	1 4 2½	1 4 0	1 4 0	1 3 7½	1 3 8½	1 3 6	1 2 11	1 2 6	1 2 1½	1 1 7½	1 2 3	1 2 6	1 3 1
1925	1 2 6	1 2 1½	1 2 0	1 2 0	1 2 0	1 1 6	1 0 6	1 0 0	1 0 0	1 0 0	1 0 3	1 0 10½	1 1 1½
1926	1 1 1½	1 1 6	1 1 6	1 1 3½	1 1 3	1 1 5½	1 1 6	1 1 6*	1 1 0*	1 1 6*	1 1 6*	1 1 6*	1 1 4½
1927	1 2 1½	1 2 3	1 2 1½	1 2 0	1 2 6	1 2 0½	1 1 7½	1 1 0	1 1 0	1 1 0	1 1 0	1 1 0	1 1 7½
1928	1 1 0	1 1 1½	1 1 11	1 2 4½	1 2 6	1 2 6	1 2 6	1 2 6	1 2 6	1 2 6	1 2 6	1 2 6	1 2 2½
1929	1 2 6	1 2 6	—	—	—	—	—	—	—	—	—	—	—

* Prices nominal.

WILLIAM JACKS & COMPANY,

WINCHESTER HOUSE, OLD BROAD ST., LONDON, E.C.2.

18, BENNETTS HILL, BIRMINGHAM.

PIG IRON

REGISTERED TRADE MARK

SCOTCH, MIDDLESBRO', HEMATITE, BASIC, SPECIALS, &c.

NON-FERROUS METALS

COPPER, TIN, LEAD, SPELTER, ANTIMONY, CHROME ORE.

WILLIAM JACKS & COMPANY,

19, ST. VINCENT PLACE, GLASGOW.

ZETLAND ROAD, MIDDLESBROUGH

SMALL ADVERTISEMENTS.

Notice.

Small Advertisements in this section of the Journal are accepted at the prepaid rate of 6d. per line, first line in capitals counting two, average 6 words per line. Minimum charge for one insertion 3/-

(A remittance should accompany instructions.)

SITUATIONS VACANT AND WANTED.

PRACTICAL Foundry Foreman (36), 15 years' experience as same, seeks situation; practical experience plate machine, loose pattern and strickle work for machine tool, electrical and general engineers' castings, ¼ cwt. to 35 tons, mixing iron, brass and semi-steel to specifications.—Box 120, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

STEEL Foundry Manager desires engagement; 25 years' experience, possessing wide knowledge of steel castings from a few pounds up to 25 tons; also thorough knowledge of piecework and prices and up-to-date foundry practice; thoroughly capable of taking full charge of all departments; willing to invest small capital.—Address, Box 122, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

PATENT.

THE Proprietor of the Patent No. 163543 for Improvements in Rotary Furnaces is desirous of entering into arrangements by way of licence and otherwise on reasonable terms for the purpose of exploiting the same and ensuring its full development and practical working in this country. All communications should be addressed in the first instance to Haseltine, Lake & Company, Chartered Patent Agents, 28, Southampton Buildings, Chancery Lane, London, W.C.2.

SALE BY PRIVATE TREATY.

TRAFFORD PARK, MANCHESTER.

For Sale by Private Treaty at a bargain price.

MODERN FOUNDRY—ERECTED 1921, with Railway Sidings into Works. Excellent Warehouse and Packing Room and fine Suite of Offices. Area of land 7,173 sq. yds., of which 2,850 are covered by a one-storey erection on same level. Easily adaptable for other trades.

To treat: F. S. AIREY, ENTWISTLE & COMPANY, 10, Norfolk Street, Manchester.

MACHINERY.

WANTED, SECOND-HAND CUPOLA, 5 tons per hour, in good condition, with or without electric-driven fan 220 volts D.C.—Send price and full particulars to Box 100, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

SAND MIXERS.—New and second-hand. Ask us to quote.—W. BREALEY & COMPANY, LIMITED, Prospect Works, Hawksley Avenue, Sheffield.

'PHONE 98 STAINES.

12/14-h.p. Petter Cold Starting Crude Oil Engine.

Air Receiver, 8 ft. x 4 ft., 100 lbs. w.p.

Hydraulic Accumulator, 10-in ram, 12-ft. stroke.

12-h.p. Modern Crossley Gas Engine, variable admission.

HARRY H. GARDAM & COMPANY, LIMITED, Staines.

MACHINERY.—*Continued.*

3 FT. dia. Whiting pattern Cupola, by W. Jackman; been little used; complete; as new; £60.—A. HAMMOND, 14, Australia Road, Slough.

FOR SALE, complete Melting Plant, including two 6 ft. diameter Cupolas, charging elevator with motor, fan and motor, charging platform, firebricks, charging skips; practically new; replaced with larger; cheap for immediate sale.—Box 126, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

12-in. x 50-in. "CHURCHILL" Universal Grinding Machine.

No. 11 "BROWN & SHARPE" 6-in. x 32-in. Plain Grinding Machine.

BRYANT No. 6 Chucking Grinder, chuck range 12 in.

"CINCINNATI" No. 3 12-in. x 48-in. Universal Tool and Cutter Grinder.

Two LANCASHIRE BOILERS, 30 ft. x 7 ft. 6 in., reinsure 150 lbs. pressure.

LANCASHIRE BOILER, 30 ft. x 7 ft. 6 in., reinsure 120 lbs. pressure.

5-ton "GRAFTON" LOCO. STEAM CRANE, 25-ft. steel jib, all motions, 80 lbs. W.P.

THIRTY (30) HORIZONTAL DOUBLE-GEARED STEAM WINCHES (Clarke Chapman), cyls. 4½ in. x 6 in., drum 22 in. dia. x 20 in. wide, brake.

CATALOGUE (10,000 Lots) ON APPLICATION.

THOS. W. WARD, LTD.,
ALBION WORKS, SHEFFIELD.

MOULDING MACHINES.—For Sale, Britannia No. 2 Jolter, pattern draw 15 in., price £55; Mumford plain Jolter, table 20 in.-15 in., price £12; both these machines are equal to new.—Box 988, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

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